Issued January 1968

SOIL SURVEY

Cabezon Area, New Mexico

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
and
UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Land Management
In cooperation with
NEW MEXICO AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1961–62. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the Area in 1962. This survey was made cooperatively by the Soil Conservation Service, United States Department of Agriculture; the Bureau of Land Management, United States Department of the Interior; and the New Mexico Agricultural Experiment Station. It is part of the technical assistance furnished to the Cuba Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing ranches and rangeland; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

The soils of the Cabezon Area are shown on the detailed map at the back of this survey. This map consists of many sheets that were made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists the soils of the Area in alphabetic order by map symbol. It shows the page where each kind of soil is described and also the page for the range site in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of the soils for many specific purposes can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Ranchers and others interested in the use of rangeland can find, under "Range Management," groupings of the soils according to their suitability for range, descriptions of the vegetation on each site, and suggestions for management.

Foresters and game managers can find brief information in the sections "Woodland" and "Wildlife."

Engineers and builders will find under "Engineering Properties of the Soils" tables that show characteristics of the soils in the survey Area that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Genesis, Classification, and Morphology of the Soils."

Students, teachers, and others will find information about soils and their management in various parts of the text, according to their special interests.

Newcomers in the Cabezon Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the Area."

Cover picture: Cabezon Peak, a prominent landmark in the southern part of the Cabezon Area.

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NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued January 1968

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF CABEZON AREA, NEW MEXICO

BY JAMES J. FOLKS, SOIL CONSERVATION SERVICE, AND WALTER B. STONE, BUREAU OF LAND MANAGEMENT

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, AND UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT, IN COOPERATION WITH THE NEW MEXICO AGRICULTURAL EXPERIMENT STATION

THE CABEZON AREA is in the northwestern part of Sandoval County, which is in northwestern New Mexico (fig. 1). The Area totals 374,728 acres or about 585 square miles. About 80 percent of this is public domain administered by the Bureau of Land Management. Part of the rest is State owned, and part is privately owned. Most of the acreage is rangeland. Less than 1 percent is farmed.

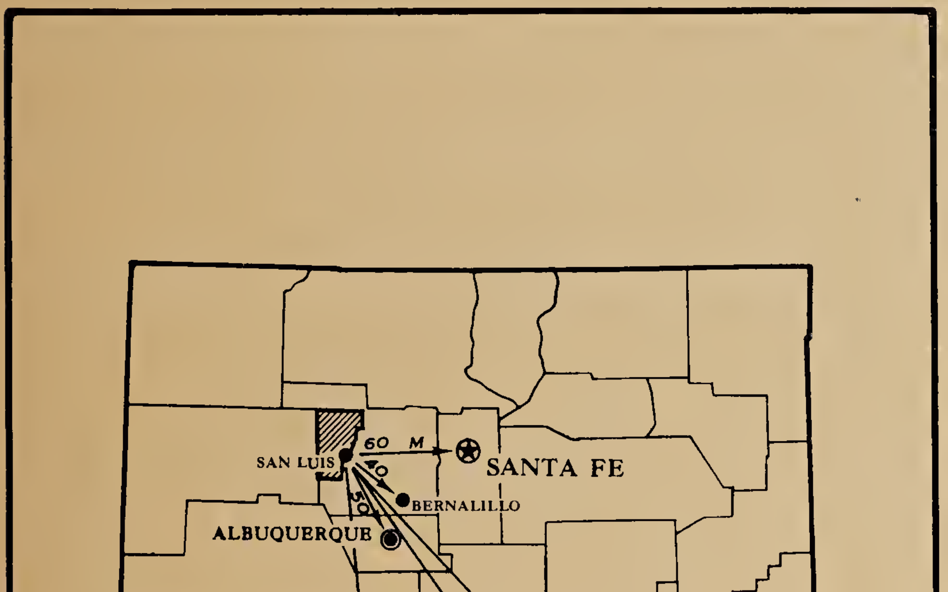

Figure 1.—Location of the Cabezon Area in New Mexico.

Between 1920 and 1940, homesteaders settled in the northwestern part of the Area. They acquired tracts of 320 to 640 acres, on which they grew beans and corn successfully in some years. But lack of water made farming risky, and raising of livestock gradually replaced the production of crops. The numbers of livestock increased, and soon the feed requirements exceeded the output of forage.

In the mid 1930's, the Federal Government began to buy land in the Area. Many farmers and stockmen sold their tracts. Farming has almost ceased, and ranching is now the main source of income. The Bureau of Land Management can grant permits for the use of the Federally owned acreage for grazing. Navajo Indians raised sheep and a few goats on small allotments, but most of the rangeland is used by other permit-holders to graze cattle.

There are no towns in the Area. The Torreon and Johnson Indian trading posts are the only places of business. Cuba, N. Mex., a town of 841 population, is located about 2 miles north of the Area.

How This Soil Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in the Cabezon Area, where they are located, and how they can be used. They went into the Area knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the Area, they observed steepness, length, and shape of slopes; width and depth of arroyos; kinds of native plants; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the underlying material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this soil survey efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer,

the main horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Las Lucas, for example, is the name of a soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the natural, undisturbed landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. The difference in texture of the surface layer is apparent from the name. In this survey Area, each of the series recognized is represented by only one type.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Las Lucas loam, 0 to 5 percent slopes, is one of two phases of Las Lucas loam, a soil that has a slope range of 0 to 9 percent.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show arroyos, roads, mesas, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this soil survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of rangeland, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized type or phase.

Most surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be called soil. These areas are shown on the map like other mapping units, but they are given descriptive names, such as Badland or Alluvial land, and are called land types rather than soils.

Some mapping units are made up of soils of more than one series, of different types and phases within the same series, or of a soil and a land type. One such mapping unit is the undifferentiated group, which consists of two or more components that occur together without regularity in pattern or relative proportion. The individual tracts could be shown separately on the map, but the differences are not important for the objectives of the soil survey. An example is Billings and Persayo silty clay loams.

Another kind of mapping unit is the soil association. It is a large acreage that consists of two or more soils or of a soil and a land type. The pattern and proportion of the components are uniform, though the significant characteristics may differ greatly. An example is Litle-Las Lucas association.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data have been assembled. The mass of detailed information then needs to be organized in such a way that it is readily useful to different groups of readers, among them ranchers, managers of rangeland, and engineers. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil surveys. The soil scientists set up trial groups and test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. The groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this soil survey shows, in color, the soil associations in the Cabezon Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning management, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The six soil associations in the Cabezon Area are described in the following pages.

1. *Christianburg-Navajo association*

Nearly level, gullied, saline and alkali soils on bottom lands

This association forms a narrow band of gullied, saline and alkali soils along the Rio Puerco and its tributaries. It is about 60 percent Christianburg soils, 30 percent Navajo soils, and 10 percent Billings soils. The total extent is about 16,000 acres, or a little less than 5 percent of the survey Area.

Generally, the soils in this association have a surface layer of silty clay or clay and a subsoil of clay that cracks as it dries. Christianburg soils have a grayish-brown surface layer and a subsoil of coarse prismatic structure. Navajo soils have a reddish-brown surface layer and a blocky subsoil. Billings soils are moderately fine textured.

The soils in this association are strongly alkaline. Permeability is very slow, and surface runoff is rapid. Drainage is somewhat poor or poor. Slickspots (small alkali-affected areas) are common. Water stands on these for several days after each rain.

Although nearly level, these soils are severely eroded and are subject to further erosion. Some of the vertical-walled gullies are 20 to 40 feet deep.

The soils in this association are so strongly saline and alkali that few kinds of crops can be grown. Some areas have been farmed under irrigation, but most of these have been abandoned. The supply of water is seasonal and inadequate, and diverting water is too costly to be practical. Fair to good stands of salt-tolerant native shrubs and grasses provide forage.

Most of this association is publicly owned and is administered by the Bureau of Land Management. A few small scattered tracts are privately owned. Practically no ranches are headquartered here.

2. *Litle-Las Lucas association*

Rolling or hilly, eroded soils on uplands and low shale hills

This association is on rolling or hilly uplands and low shale hills. One of the two main areas of this association is in the southeastern corner of the survey Area, and the other forms a band about 4 miles wide that extends across the north-central part of the Area and then runs north along the Rio Puerco. About 45 percent consists of Litle soils, 35 percent of Las Lucas soils, and 20 percent of Persayo soils. The total extent is about 62,000 acres, or more than 15 percent of the survey Area.

Litle soils are on uplands. They are moderately deep. They commonly have an olive-brown surface layer and a subsoil of light yellowish-brown, friable silty clay of blocky structure. Las Lucas soils also are on uplands. They are deep and moderately deep. They have a surface layer of light-colored loam and a subsoil of friable, blocky clay loam. Persayo soils, which are on low hills, are shallow and very shallow and grade into shale. Their surface layer is light-colored loam to silty clay loam. Their subsoil is light olive-brown silty clay loam to light clay loam of blocky structure.

The soils in this association are mildly or moderately alkaline. Their surface layer contains some free lime, and their subsoil contains many salt crystals, principally of gypsum. Permeability is slow, and erosion is a hazard because of runoff.

This association is used mainly for range. Fair to good stands of short grasses provide forage (fig. 2).

Most of this association is publicly owned and is administered by the Bureau of Land Management. A few scattered tracts are privately owned. Much of the southern part is leased to individuals. A few Navajo Indians live on their grazing allotments in the northern part of the Area. Wagon trails are about the only access routes.

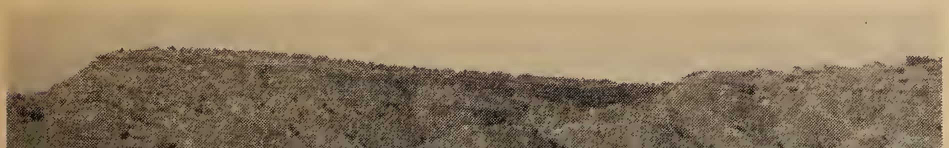

Figure 2.—Alkali sacaton on Las Lucas and Litle soils in the Litle-Las Lucas soil association. Persayo soils are on the low shale hills in the background.

3. *Penistaja-Berent-Sandstone outcrop association*

Nearly level to rolling, slightly to moderately eroded soils on uplands and ridges

This association consists of nearly level to rolling, eroded soils in the northwestern and east-central parts of the survey Area. It is about 40 percent Penistaja soils, 25 percent Berent soils, and 35 percent Alluvial land, Badland, and sandstone and shale outcrops. The total extent is about 140,000 acres, or a little less than 38 percent of the survey Area.

The soils in this association are deep and moderately deep. The slope range is mostly less than 3 percent, but it is slightly more than 5 percent in some places. Penistaja soils have a surface layer of light-colored fine sandy loam and a subsoil of friable, reddish-brown sandy clay loam or clay loam of blocky structure. Berent soils have a surface layer of light-brown loamy fine sand and a subsoil of firm loamy sand.

Erosion is a slight to moderate hazard, and controlling gully erosion and wind erosion is a problem. Scattered Slickspots of strongly alkaline soil occur. Berent soils have a good rate of water intake. Some areas of these soils were once dryfarmed, but they have since been abandoned.

Short grasses and sagebrush, which are the main plants on this association, provide the best forage production in the survey Area. There are scattered stands of pinyon and juniper trees, which are cut for fenceposts and firewood.

Most of this association is publicly owned and is administered by the Bureau of Land Management. Only a few tracts are privately owned. Few ranches are headquartered here. A few Navajo Indians have grazing allotments.

4. *Basalt outcrop-Cabezon-Torreon association*

Gently sloping soils and steep and very steep, stony soils on Chivato Mesa

This association consists of gently sloping soils and steep or very steep, stony soils. It is in the southwestern corner of the survey Area. It is about 48 percent Basalt outcrop, 40 percent Cabezon soils, 10 percent Torreon soils, and 2 percent intermittent lakes. The total extent is about 15,000 acres, or about 4 percent of the survey Area.

Generally, the soils in this association have a surface layer of grayish-brown, friable loam or stony loam and a subsoil of blocky clay. In some places these soils are underlain by basalt and their substratum may contain a large amount of gravel. The basalt outcrops are very steep and occur as escarpments and plugs. Cabezon soils are stony, have a friable, dark-brown subsoil of blocky structure, and are shallow over basalt that is coated with lime in places. Torreon soils have a very firm, reddish-brown subsoil that has subangular blocky structure.

The soils in this association are moderately to slowly permeable. They are free of lime to a depth of 15 to 30 inches, and they have a small amount of free lime in the substratum. The soil material in the lakebeds is very dark colored, clayey, and high in organic-matter content.

This association is mostly in native grass, but there are scattered stands of ponderosa pine and, on the stony

soils, thick stands of pinyon and juniper (fig. 3). The extensive areas of Basalt outcrop are of use mainly as wildlife habitats.

All of this association is publicly owned and is administered by the Bureau of Land Management. It is mostly within the old Ignacio Chavez Spanish Grant.

Figure 3.—**Native grass on Torreon soils in the Basalt outcrop-Cabezon-Torreon soil association. Pinyon and juniper and some ponderosa pine on stony Cabezon soils in the background.**

5. *Billings-Persayo association*

Nearly level to steep, gullied soils on foothills, alluvial fans, and flood plains

This association consists of nearly level to steep, gullied soils in the northwestern part of the survey Area. It is on the foothills of the Nacimiento Mountains and on alluvial fans and flood plains. The acreage is about 50 percent Billings soils, 30 percent Persayo soils, 3 percent Fronton soils, 3 percent Prewitt soils, and 14 percent Badland and outcrops of sandstone and shale. The total extent is about 31,000 acres, or less than 9 percent of the survey Area.

Billings soils, which are on flood plains and alluvial fans, are deep. They have a surface layer of light brownish-gray very fine sandy loam to silty clay loam. Their subsoil is friable, grayish-brown silty clay loam of blocky structure. Persayo soils are on foothills and are shallow over sandstone. They have a surface layer of light-colored loam to silty clay loam. Their subsoil is light olive-brown silty clay loam of blocky structure. Fronton soils, which are also on foothills, have a surface layer of light-colored gravelly loam and a subsoil of firm, reddish-brown, subangular blocky gravelly clay. Stones cover the surface in some places. Prewitt soils, which are on bottom lands, have a thick, reddish-brown surface layer. Their subsoil and substratum are stratified but are mostly loam.

The soils in this association are slowly permeable. Geologic erosion is active; many deep, vertical-walled gullies have cut into the alluvial soils.

The vegetation is mostly native short grasses. It provides a fair amount of forage. Pinyon and juniper cover the rough and stony areas, and scattered pines grow on the high ridges. Trees are cut for firewood and fenceposts.

Most of this association is publicly owned and is administered by the Bureau of Land Management. A few scattered tracts are privately owned. Ten or 15 ranches are headquartered here. The only paved road in the Area provides access to them.

6. *Travessilla-Persayo association*

Strongly sloping to steep, eroded soils on mesas and breaks

This association is rough and broken. It makes up most of the central part of the survey Area and a small acreage along the northern border. Travessilla soils account for about 40 percent of the association, Persayo soils for 40 percent, and Penistaja soils for 2 percent. The remaining 18 percent consists of Badland, Alluvial land, Alkali alluvial land, and sandstone and shale outcrops. The total extent is 110,000 acres, or a little more than 29 percent of the survey Area.

Generally, the soils in this association are shallow. They are light colored and friable. The subsoil is thin and grades into sandstone and shale. Travessilla soils have a sandy loam surface layer and a light grayish-brown subsoil of granular structure. Persayo soils have a surface layer of loam to silty clay loam. The subsoil is light olive-brown silty clay loam of blocky structure. Penistaja soils, which are in flat areas between and upslope from the drainageways, are deep, are light colored, and have a sandy clay loam subsoil.

The soils in this association are mildly alkaline and have free lime in the surface layer. They are cut by many intermittent drainageways. Rock outcrops and vertical-walled escarpments are common. Geologic erosion is severe. Controlling runoff and erosion are major problems.

The vegetation is native grass. Forage production is low, but sheep and goats graze the year round. There are scattered pinyon and juniper trees (fig. 4).

Most of this association is publicly owned and is administered by the Bureau of Land Management. Few areas are privately owned. Some Navajo Indians live on their grazing allotments. Wagon trails are about the only access routes.

Figure 4.—**A typical area of the Travessilla-Persayo soil association.**

Descriptions of the Soils

This section describes the soil series and land types in the Cabezon Area and shows the major layers of a profile

typical of each series. Following the description of each series, each mapping unit in the series is discussed. More detailed information about the series can be found in the section "Genesis, Classification, and Morphology of the Soils." Many of the terms commonly used in describing the soils are defined in the Glossary.

Following the name of each mapping unit is the symbol that identifies the soil or land type on the detailed map at the back of the soil survey. Shown at the end of each description is the range site in which the mapping unit has been placed. The page on which each mapping unit and each site is described is listed in the "Guide to Mapping Units," near the back of the survey. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The soils in the Area formed in alluvium, colluvium, eolian deposits, or a mixture of alluvium and eolian deposits. The original vegetation was grass. In texture, color, and consistence, the soils vary widely. Nearly all are low in organic-matter content. A large proportion of the soils on bottom lands is saline and alkali. Soils that formed in material derived from shale are high in soluble salts and are susceptible to piping.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Alkali alluvial land	11, 584	3. 1
Alluvial land	3, 556	. 9
Badland	7, 058	1. 9
Basalt outcrop-Cabezon association	13, 882	3. 7
Berent loamy fine sand, 0 to 5 percent slopes	8, 060	2. 2
Berent loamy fine sand, 5 to 9 percent slopes	2, 243	. 6
Berent-Sandstone outcrop association	26, 586	7. 1
Billings silty clay loam and Gullied land	7, 924	2. 1
Billings silty clay loam, alkali, and Gullied land	7, 312	2. 0
Billings and Persayo silty clay loams	5, 502	1. 5
Cabezon-Basalt outcrop association	5, 122	1. 4
Christianburg clay and Gullied land	13, 609	3. 6
Fronton-Travessilla-Persayo association	1, 202	. 3
Fruitland sandy loam	9, 352	2. 5
Fruitland-Slickspot association	6, 061	1. 6
Las Lucas loam, 0 to 5 percent slopes	6, 202	1. 7
Las Lucas loam, 5 to 9 percent slopes	1, 253	. 3
Las Lucas soils, 5 to 9 percent slopes	5, 005	1. 3
Las Lucas-Persayo association	16, 146	4. 3
Litle silty clay, 1 to 5 percent slopes	2, 949	. 8
Litle silty clay, 5 to 9 percent slopes	806	. 2
Litle-Las Lucas-Persayo association	3, 565	1. 0
Litle-Persayo association	16, 327	4. 3
Navajo clay and Gullied land	5, 337	1. 4
Penistaja fine sandy loam, 0 to 5 percent slopes	38, 117	10. 2
Penistaja fine sandy loam, 5 to 9 percent slopes	3, 021	. 8
Penistaja-Berent association	6, 588	1. 7
Penistaja-Sandstone outcrop association	10, 720	2. 9
Persayo gravelly soils-Shale outcrop association	3, 252	. 9
Persayo-Shale outcrop association	1, 006	. 3
Prewitt loam and Gullied land	1, 401	. 4
Ravola silty clay loam and Gullied land	6, 442	1. 7
Ravola silty clay loam, alkali, and Gullied land	1, 311	. 3
Rock outcrop-Travessilla-Persayo association	79, 085	21. 1
Sandstone outcrop-Travessilla association	2, 914	. 8
Shavano-Berent association	4, 436	1. 2
Torreon loam	809	. 2
Travessilla-Persayo-Billings association	26, 008	6. 9
Stream channels	2, 975	. 8
Total	374, 728	100. 0

All the soils of the Area have been affected to some degree by either wind or water erosion. The underlying rocks have low water-holding capacity, and as a consequence runoff is rapid. Geologic erosion is active, and because of the steep terrain and the shallow soils, little can be done to check it. Accelerated erosion has resulted from the exposure of the soils through overgrazing or, less extensively, through tillage. The most serious damage has been done by gully erosion. Some areas are so severely gullied that parts of the range are inaccessible to livestock. In such areas, the pattern of gullies is dendritic, the central gully having formed in a stream channel. The central gully and the larger side gullies range from 20 to 30 feet in depth and from 20 to 200 feet in width. Experiments with ripping and pitting as means of checking runoff and thereby limiting erosion indicate that these practices have only a short-time effect.

Alluvial Land

Alluvial land is deep, light colored, and nearly level or gently sloping. It occurs on alluvial fans and flood plains and is scattered throughout the survey Area.

The surface layer commonly is about 10 inches thick. It is very pale brown, contains some free lime, and has granular structure. The texture ranges from loamy fine sand to loam.

The subsoil is light yellowish brown, is structureless, and is slightly more compact than the surface layer. It consists of stratified loam, sandy loam, and clay loam derived from alkaline shale and sandstone and deposited by streams.

The underlying material also is stratified, and it contains some free lime. It is easily penetrated by plant roots.

Alluvial land is well drained. Internal drainage is medium, and permeability is moderate to slow. The organic-matter content is low. Gully erosion is a serious hazard.

Alluvial land is in native grass.

Alkali alluvial land (Ak) (0 to 5 percent slopes).—This mapping unit occurs along intermittent drainageways throughout the survey Area. It has very rapid surface runoff. Small active gullies are common, and there are a few gullies 10 to 40 feet deep.

Included in the areas mapped are a few small areas of Billings silty clay loam, alkali, and Gullied land, and of Ravola silty clay loam, alkali, and Gullied land. Also included are Slickspots.

Some areas could be cleared of brush and then reseeded. Brush and rock dams could be used to control erosion. On-site investigations are needed if the construction of earth dams or of diversion ditches is planned. Some layers of the soil material contain so much alkali that they are poor for engineering uses. (Salt Flats range site)

Alluvial land (Au) (0 to 5 percent slopes).—This mapping unit occurs along intermittent drainageways throughout the survey Area. It is similar to Alkali alluvial land, but it lacks the sodium salts and includes only small, scattered Slickspots. It is dissected by many shallow rivulets and a few gullies 2 to 4 feet deep.

Included in the areas mapped are a few small areas of Billings silty clay loam and Gullied land, and of Ravola silty clay loam and Gullied land.

Water spreading, brush control, and reseeding would help to increase forage production and would control gully erosion. (Loamy Upland range site)

Badland

Badland (Ba) (20 to 75 percent slopes) is steep or very steep and nearly barren. It is scattered throughout the survey Area. The surface is dissected by many drainage channels. About 80 to 90 percent of the acreage is raw shale and sandstone. Mesa escarpments are covered with sandstone fragments. Local variations in relief are as much as 500 feet. Runoff is very rapid, and geologic erosion is active.

Included in the areas mapped are small pockets of Travessilla soils, which are shallow over sandstone, and of Persayo soils, which are shallow or very shallow over shale.

Badland is useful mainly as scenery, wildlife habitat, and watersheds. It is of little or no value as range.

Basalt Outcrop-Cabezon Association

Basalt outcrop-Cabezon association (Bc) (9 to 75 percent slopes) occurs only in the southern part of the survey Area. It occupies moderately steep to very steep slopes and breaks and is 200 to 1,000 feet above the general level of the terrain.

Basalt outcrop makes up 45 to 60 percent of the acreage, and the moderately steep, shallow to moderately deep, well-drained Cabezon soils 25 to 40 percent. About 15 percent of the acreage consists of Sandstone outcrop, Shale outcrop, and minor areas of Alluvial land.

The areas furnish limited grazing and are useful as wildlife habitat. Mechanical conservation measures generally are not feasible. (Basalt outcrop—Malpais Breaks range site; Cabezon—Pine Grassland range site)

Berent Series

The Berent series consists of deep and moderately deep, light-colored, nearly level to strongly sloping soils on the tops of mesas.

The surface layer of these soils consists of light-brown loamy fine sand that is free of lime and has granular structure.

Beneath this is a layer of brown loamy sand. It has a weak, medium, subangular blocky structure and a slightly sticky consistence. Numerous root and worm channels have been filled with material from the surface layer.

The underlying material is sandy. It is easily penetrated by moisture and plant roots. The depth to sandstone typically is more than 60 inches but may be as little as 36 inches.

Berent soils take in water rapidly but have a low water-holding capacity. They are excessively drained, except where the underlying sandstone is near enough to the surface to cause a perched water table. Red and yellow mottles just above the sandstone are evidence that a perched water table has existed. Typically, these soils are free of lime, but in places they are calcareous to the surface. They are easy to work but are low in natural fertility. If overgrazed or left bare, they are highly susceptible to wind erosion.

These soils are in native grass. They were once dryfarmed but are no longer used for crops.

Berent loamy fine sand, 0 to 5 percent slopes (Bd).—This soil occurs mainly in the northwestern part of the survey Area. All of it is at least slightly to moderately eroded, and the unprotected areas once dryfarmed are severely eroded. The surface layer is about 8 inches thick. Beneath this is a layer, about 5 inches thick, of fine sandy loam. This soil is free of lime.

Included with this soil in mapping were a few small areas of Berent loamy fine sand, 5 to 9 percent slopes, and minor areas of Penistaja fine sandy loam, 0 to 5 percent slopes.

Controlling wind erosion is the main conservation problem. Gullies caused by water erosion can be stabilized with brush and rock dams. (Deep Sand range site)

Berent loamy fine sand, 5 to 9 percent slopes (Be).—This soil occurs as small scattered tracts, mainly in the northwestern part of the survey Area. Surface runoff is slow, even on the strongest slopes, because most of the water is absorbed. Some areas are slightly calcareous to the surface.

Water erosion and wind erosion are hazards. Brush and rock dams can be used to control erosion in some places, but earthen structures are not likely to be effective. (Deep Sand range site)

Berent-Sandstone outcrop association (Bf) (1 to 25 percent slopes).—This unit occurs mainly in the northern part of the Area.

Berent soils make up about 70 percent of the acreage. These soils are nearly level, and runoff is very slow. The vegetation consists of good stands of pinyon and juniper and some grass as an understory.

Sandstone outcrop, which makes up the steeper parts of this association, is scattered throughout, in no definite pattern; it totals about 30 percent of the acreage. The outcrops are nearly bare. The vegetation consists of scattered pinyon, juniper, and ponderosa pine trees. The barren areas are useful only as wildlife habitat. (Berent—Deep Sand range site; Sandstone outcrop—Sandstone Breaks range site)

Billings Series

The Billings series consists of deep, light-colored, nearly level to strongly sloping soils on alluvial fans and flood plains.

The surface layer of these soils consists of light brownish-gray silty clay loam to very fine sandy loam that is almost free of lime. This layer has a platy structure and a very friable consistence.

Below the surface layer is a thick layer of grayish-brown clay loam or silty clay loam that becomes increasingly limy with depth. It has a weak prismatic structure that breaks to subangular blocky and has a slightly hard to very hard consistence.

The underlying material is silty clay loam that contains much lime and many gypsum crystals.

Billings soils are well drained, are slowly permeable, and have a high water-holding capacity. They are highly susceptible to water erosion, and deep, vertical-walled gullies are common.

These soils are used for native range.

Billings silty clay loam and Gullied land (Bg) (0 to 5 percent slopes).—This mapping unit occurs as small scattered areas, mainly in the northeastern part of the survey

Area. Surface runoff is rapid. Gullies that are 10 to 40 feet deep and have tributary gullies 2 to 5 feet deep are common (fig. 5). Included in the areas mapped are small acreages of Persayo-Shale outcrop association and of Christianburg clay and Gullied land.

Figure 5.— **Gully erosion in Billings silty clay loam and Gullied land.**

The surface layer of the Billings soil in this unit is about 4 inches thick and has a ¼-inch dispersed crust. Beneath the surface layer is a thick layer of silty clay loam or clay loam that lacks distinct horizons. The amount of lime in the soil increases with depth.

Conservation practices that may be needed include brush clearing, pitting, chiseling, and reseeding. Water spreading and the construction of erosion-control dams would help to stabilize the gullies. The soil material is fairly stable if compacted at optimum moisture content. (Clayey Upland range site)

Billings silty clay loam, alkali, and Gullied land (Bk) (0 to 5 percent slopes).—This mapping unit is on flood plains and alluvial fans and is scattered throughout the survey Area. Numerous Slickspots are on the surface, and sodium-affected layers occur within the profile. There are many deep, vertical-walled gullies and many rivulets 1 to 2 feet deep. Surface runoff is rapid.

Included in the areas mapped are a few small areas of Ravola silty clay loam, alkali, and Gullied land, and of Christianburg clay and Gullied land.

Brush clearing and reseeding are effective conservation measures. Brush and rock dams would help to control gully erosion. On-site investigations should be made before earthen dams are built. (Salt Flats range site)

Billings and Persayo silty clay loams (Bp) (1 to 25 percent slopes).—This mapping unit occurs in the northeastern part of the survey Area.

Billings soils, which make up about 70 percent of the acreage, occupy valley slopes and bottom lands. Their vegetation consists of good stands of sagebrush and blue grama.

Persayo soils, which make up about 20 percent, occur on ridges, steep side slopes, and low knolls. They have sparse stands of pinyon and juniper and some grass as an understory.

Included in the areas mapped are minor acreages of Litle silty clay, 5 to 9 percent slopes, and small areas of Fronton-Travessilla-Persayo association.

(Billings—Clayey Upland range site; Persayo—Shale Hills range site)

Cabezon Series

The Cabezon series consists of shallow to moderately deep, moderately dark colored, moderately steep soils on the tops and fronts of mesas in the southwestern part of the survey Area.

The surface layer of these soils ranges from stony loam to stony light clay loam in texture. It is grayish brown, is very friable, and contains no free lime.

The subsoil is clay loam to clay of moderate, medium, blocky structure. Below the subsoil is basalt, sandstone, or shale.

Cabezon soils are well drained. Internal drainage is medium, and permeability is moderate. The water-holding capacity is low because bedrock is near the surface. The natural fertility is high. Erosion is a slight hazard.

Cabezon soils produce good stands of native grass and some low-grade ponderosa pine. In this Area these soils are mapped only as part of an association with Basalt outcrop.

Cabezon-Basalt outcrop association (Cb) (9 to 25 percent slopes).—This unit occurs on ridgetops and side slopes in the southwestern corner of the survey Area.

Cabezon soils make up about 45 percent of the acreage. These soils are moderately steep, shallow, and well drained. Runoff is slow. The vegetation consists of scattered stands of ponderosa pine and a good cover of grass as an understory.

Basalt outcrop makes up about 40 percent of this unit. Besides the bare outcrops, there are large basalt boulders and small pockets of soil material between the boulders. Pinyon trees, ponderosa pine trees, and oak brush grow in the patches of soil material.

About 15 percent of the association consists of nearly level Torreon soils. These soils are between the ridges. They have a good cover of grass and some scattered pinyon and juniper trees.

No mechanical conservation measures are practical. The most serious limitation is a lack of water. (Cabezon—Pine Grassland range site; Basalt outcrop—Malpais Breaks range site)

Christianburg Series

The Christianburg series consists of deep, light-colored, nearly level and gently sloping soils on the flood plains of the Rio Puerco and its tributaries.

The surface layer of these soils consists of grayish-brown silty clay to clay that has granular structure and is extremely hard to work. It contains little lime.

The subsoil is a very thick layer of grayish-brown clay that has a coarse prismatic structure. Coarser textured strata occur in some places. This layer is hard and dense and, in many places, has pronounced vertical cracks resulting from shrinkage.

The underlying material is fine textured and contains much salt. It is extremely dense and is not easily penetrated by roots.

Christianburg soils are well drained, are very slowly permeable, and have slow internal drainage. They have high water-holding capacity but do not release water readily to plants. Water erosion is a serious hazard, and many deep, vertical-walled gullies have formed.

Christianburg soils are moderately to severely saline and alkali and consequently are better suited to salt-tolerant grasses than to other plants. The vegetation is native grass. A small acreage formerly farmed has been abandoned.

Christianburg clay and Gullied land (Cg) (0 to 3 percent slopes).—This mapping unit occurs mainly along the Rio Puerco. The soil material is commonly saline and alkali. Water stands in low depressions until it evaporates, since the surface layer is dispersed and absorbs water very slowly. Deep, vertical-walled gullies are numerous.

Included in areas mapped as this unit are a few small areas of Navajo clay and Gullied land, and minor areas of Billings silty clay loam, alkali, and Gullied land.

Brush control and reseeding are needed where the vegetation is dominated by noxious brush. Water spreading and erosion control are needed. All earthwork requires compaction at optimum moisture content, to insure stability and prevent piping. (Salt Flats range site)

Fronton Series

The Fronton series consists of shallow to moderately deep, light-colored, steep and moderately steep soils on gravel-mantled foothills in the northeastern part of the survey Area.

The surface layer of these soils is light-brown, very friable, gravelly very fine sandy loam or gravelly loam to gravelly light clay loam and has little or no free lime. Igneous rock fragments and gravel cover about 75 percent of the surface.

The subsoil is about 35 percent gravel. The upper part is reddish-brown gravelly clay of moderate to strong, very fine, subangular blocky structure. The lower part is light reddish-brown gravelly clay of blocky structure. The lower part is more compact than the upper part.

The underlying material is strongly calcareous, gray shale.

Fronton soils are well drained. Internal drainage is medium, and permeability is moderate. The water-holding capacity varies with depth and with the amount of gravel. Natural fertility is high. The rock and gravel on the surface help to control erosion.

For the most part, these soils support pinyon, juniper, some ponderosa pine, and an understory of grasses.

Fronton soils are mapped in this Area only with Travessilla and Persayo soils.

Fronton-Travessilla-Persayo association (Fp) (9 to 25 percent slopes).—Fronton soils make up about 50 percent of this mapping unit. These soils are shallow to moderately deep, steep or moderately steep, and well drained. The vegetation consists of pinyon and juniper and a good understory of grasses.

Travessilla and Persayo soils each make up about 20 percent of this unit. These soils occur on ridges and side slopes and are shallow and very shallow. The vegetation consists of sparse stands of pinyon and juniper and an understory of grass.

Areas of Billings silty clay loam and Gullied land were included in the areas mapped as this unit. These areas are on bottom lands and make up about 10 percent of the acreage.

Numerous intermittent drainageways cross this association. (Fronton—Gravelly Upland range site; Travessilla—Shallow Upland range site; Persayo—Shale Hills range site)

Fruitland Series

The Fruitland series consists of deep, light-colored, nearly level to strongly sloping soils on alluvial fans. These soils are scattered throughout the survey Area.

The surface layer consists of light brownish-gray loamy sand to sandy loam or loam that is free of lime. This layer has a granular structure and a very friable consistence.

The subsoil is light brownish-gray sandy loam of weak blocky structure. The lower part contains large amounts of sodium salts.

The underlying material is stratified sandy loam or sandy clay loam. It is friable and is easily penetrated by plant roots.

Fruitland soils are well drained. Internal drainage is medium, permeability is moderate, and the water-holding capacity is high. The organic-matter content is low. Wind erosion and water erosion are hazards.

These soils are used for native range.

Fruitland sandy loam (Fr) (0 to 5 percent slopes).—This soil occurs as small tracts scattered throughout the survey Area. It is moderately eroded and is marked by many small gullies and rivulets. Surface runoff is medium. The vegetation is native grass.

The surface layer of this soil is about 4 inches thick. The subsoil consists of heavy sandy loam and is about 6 inches thick. Large amounts of sodium salts occur in some places at a depth of about 40 inches.

Included in the areas mapped are a few minor areas of Slickspots and of Alluvial land.

Conservation needs include seeding, brush control, water spreading, and gully control. Earthen structures can be compacted adequately if the moisture content is controlled. (Loamy Upland range site)

Fruitland-Slickspot association (Fs) (0 to 5 percent slopes).—This mapping unit is on alluvial fans, mainly in the northern part of the survey Area.

Fruitland soils make up about 60 percent of the acreage. These soils are deep, nearly level to strongly sloping, and well drained. A saline layer occurs in some places in either the subsoil or the substratum. The vegetation consists of a good stand of blue grama and sagebrush.

Slickspots make up about 40 percent of this unit (fig. 6). Although typically almost bare, Slickspots support some alkali sacaton. Runoff is very rapid.

The surface of Slickspots and, in places, the subsoil of Fruitland soils are highly dispersed; consequently, earthen structures may fail. On-site investigations should be made before any earthwork is begun, to determine what precautions are needed to prevent piping. Controlling gully erosion and wind erosion is a problem. (Fruitland—Loamy Upland range site; Slickspot—Salt Flats range site)

Figure 6.—**A typical area of the Fruitland-Slickspot association. Sagebrush grows on the Fruitland soils; the Slickspots are nearly bare.**

Las Lucas Series

The Las Lucas series consists of moderately deep and deep, light-colored, nearly level to strongly sloping soils on uplands. These soils are scattered throughout the survey Area.

The surface layer is pale brown in color and ranges from loam to sandy clay loam or clay loam in texture. This layer is friable. It contains some free lime. The structure is weak platy in the uppermost 1 or 2 inches and moderate granular in the lower part.

The upper part of the subsoil is brown heavy clay loam of moderate blocky structure. The lower part is yellowish-brown clay loam of weak, coarse, blocky structure. The subsoil of the more sloping Las Lucas soils tends to contain more salt crystals and less clay than that of the less sloping soils.

The underlying material is light clay loam that contains much lime. This material is friable and is easily penetrated by roots.

Las Lucas soils are well drained. Internal drainage is medium, permeability is slow, and the water-holding capacity is high. The natural fertility is high. Water erosion is a hazard.

Las Lucas loam, 0 to 5 percent slopes (Lc).—This soil occurs as small tracts scattered throughout the survey Area. It has rapid runoff and is slightly eroded. The vegetation is native grass.

The surface layer is about 8 inches thick. The subsoil, about 12 inches thick, is clay loam or heavy clay loam.

Included with this soil in mapping were a few small areas of Litle silty clay, 1 to 5 percent slopes, and of Persayo-Shale outcrop association.

Controlling water erosion is a major problem. Conservation needs include brush control, reseeding, water spreading, and gully control. Deferment of grazing and rotation of grazing help to preserve the better forage plants. (Loamy Upland range site)

Las Lucas loam, 5 to 9 percent slopes (Ld).—This soil occurs as small acreages scattered throughout the survey Area. Surface runoff is very rapid, and erosion is active. The vegetation is native grass.

Included in the areas mapped were a few small areas of Litle silty clay, 5 to 9 percent slopes, and minor areas of Persayo-Shale outcrop association.

Controlling water erosion is the most serious conservation problem. Conservation needs include ripping, chiseling, and reseeding. All such operations should be done on the contour. (Loamy Upland range site)

Las Lucas soils, 5 to 9 percent slopes (Le).—These soils occur mainly in the southern part of the survey Area. They have medium surface runoff and are moderately eroded. There are active small gullies and rivulets, and also a few vertical-walled gullies that are 5 to 10 feet deep.

These soils are similar to Las Lucas loam, 5 to 9 percent slopes, but some areas are strongly alkaline.

The surface layer is loam and is about 4 inches thick. The subsoil, about 20 inches thick, is heavy loam or clay loam.

Included with these soils in mapping were a few small areas of Persayo-Shale outcrop association and minor areas of Persayo gravelly soils-Shale outcrop association.

Controlling water erosion and improving the strongly alkali-affected spots are the main conservation problems. Some sites could be reseeded. On-site investigations should be made before dams, diversions, or other earthen structures are built. Brush and rock dams could be used to control erosion. (Clayey Upland range site)

Las Lucas-Persayo association (Lp) (1 to 25 percent slopes).—This mapping unit is in the central and southern parts of the survey Area.

Las Lucas soils make up about 70 percent of the acreage. These soils are on side slopes and are moderately deep or deep and nearly level to strongly sloping. The vegetation consists of good stands of blue grama and galleta.

Persayo soils make up about 30 percent of this unit. These are shallow or very shallow, steep or moderately steep soils on shale knolls and ridges. The vegetation consists of poor stands of blue grama and sacaton.

(Las Lucas—Loamy Upland range site; Persayo—Shale Hills range site)

Litle Series

The Litle series consists of moderately deep, light-colored, gently sloping and strongly sloping soils.

The surface layer of these soils is light olive brown in color and ranges from sandy clay loam or silty clay loam to light silty clay in texture. This layer contains much lime and has a very thin crust. It has a granular structure and is very friable.

The subsoil is light yellowish brown in color and ranges from heavy sandy clay loam or clay loam to silty clay in texture. The upper part contains more salt crystals than the lower part and is more compact. The number of salt crystals ranges from few to many. The subsoil has weak, medium, angular blocky structure.

The underlying material is dark-colored shale that contains many salt crystals.

Litle soils are well drained, slowly or very slowly permeable, and droughty. They have high water-holding capacity but do not release water readily to plants. The vegetation consists of native grass.

Litle silty clay, 1 to 5 percent slopes (Lr).—This soil is mainly in the northern half of the survey Area. Surface

runoff is rapid, and erosion is a moderate hazard. Small rivulets are common, and there are scattered, deep, vertical-walled gullies.

The surface layer is about 2 inches thick. The subsoil, about 22 inches thick, is silty clay. Salt crystals are abundant in the lower part of the subsoil.

Included in mapping were a few acres of a redder soil that has a sandy clay loam surface layer. These inclusions are in the extreme western part of the Area. Also included were minor areas of Litle silty clay, 5 to 9 percent slopes, and a few small areas of Persayo-Shale outcrop association.

Controlling water erosion and increasing the rate of water intake are major problems. Conservation needs include chiseling, contour furrowing, water spreading, and gully control. Brush control and reseeding are practical for some sites. Shale is near the surface, and consequently, on-site investigations are needed before any dams, reservoirs, or diversions are built. (Clayey Upland range site)

Litle silty clay, 5 to 9 percent slopes (Ls).—This soil occurs as small, scattered tracts, mainly in the western part of the survey Area. Surface runoff is rapid, and erosion is a serious hazard. Salt crystals are concentrated nearer the surface than in Litle silty clay, 1 to 5 percent slopes. The depth to shale is only about 15 inches. The vegetation is native grass.

Included with this soil in mapping were small areas of Persayo-Shale outcrop association.

This strongly sloping soil is susceptible to piping. Ripping or chiseling to increase the rate of water intake is not advisable because of the slope. Since shale is near the surface, on-site investigations are needed if earthen structures are to be built. (Clayey Upland range site)

Litle-Las Lucas-Persayo association (Lt) (1 to 25 percent slopes).—This unit occurs in the western part of the survey Area.

Litle soils make up about 50 percent of the acreage. These soils are on the side slopes of shale knolls and ridges. They are moderately deep and are gently sloping or strongly sloping. The vegetation consists of fair stands of blue grama, sacaton, and galleta.

Las Lucas soils make up about 30 percent of the association. These are deep or moderately deep, nearly level to strongly sloping soils on side slopes. They support good stands of blue grama and galleta.

Persayo soils make up about 20 percent of the association. They are on shale knolls and ridges and are moderately steep and steep. The vegetation consists of poor stands of blue grama and sacaton.

(Litle—Clayey Upland range site; Las Lucas—Loamy Upland range site; Persayo—Shale Hills range site)

Litle-Persayo association (Lu) (1 to 25 percent slopes.)—This unit occurs on uplands, mainly in the southern part of the survey Area.

Litle soils make up about 65 percent of the acreage. These soils are on the side slopes of shale hills and are moderately deep, gently sloping or strongly sloping, and well drained. The vegetation consists of fair stands of blue grama, sacaton, and galleta.

Persayo soils make up about 25 percent of the unit. These are shallow and very shallow, moderately steep and steep soils on knolls and on the crests of low hills. They support poor stands of grass.

Included in the areas mapped are minor acreages of Las Lucas loam, 0 to 5 percent slopes, and of Shale outcrop.

(Litle—Clayey Upland range site; Persayo—Shale Hills range site)

Navajo Series

The Navajo series consists of deep, nearly level soils on flood plains and terraces in the eastern part of the survey Area. These soils commonly contain an abundance of salt crystals.

The surface layer is reddish brown in color, ranges from sandy clay loam or clay loam to clay in texture, and contains some free lime. The structure is granular in the upper part and angular blocky in the lower. This layer is very hard to work.

The subsoil is reddish brown. It is very thick but lacks well-defined horizons. Typically, this layer consists of very heavy, dense clay, but it is coarser textured in places. It has weak, fine, blocky structure. Salt crystals are abundant. Vertical cracks form as the clay dries and shrinks.

The underlying material was derived from shale and sandstone and was deposited by slowly moving water. It contains much salt, is extremely firm, and is not easily penetrated by plant roots.

Navajo soils are poorly drained. Internal drainage is slow, and permeability is very slow. The water-holding capacity is high, but water is not released readily to plants. Water erosion is a serious hazard, and deep, vertical-walled gullies are common.

For the most part, Navajo soils are in native grass. They are best suited to salt-tolerant grasses.

Navajo clay and Gullied land (Ng) (0 to 3 percent slopes).—This mapping unit occurs mainly in the eastern part of the survey Area. Deep, vertical-walled gullies are common, and there are many small rivulets. A dispersed crust at the surface slows the rate of water intake and increases runoff. The vegetation is native grass, chiefly salt-tolerant species.

The surface layer of this unit is about 2 inches thick. The subsoil is a thick layer of clay that grades into the underlying material. The horizons are indistinct.

Included in mapping were a few small areas of Christianburg clay and Gullied land and of Prewitt loam and Gullied land.

Brush control and reseeding are needed where the vegetation is dominated by noxious brush. Waterspreading and erosion-control structures may be needed also. All earthwork requires compaction at optimum moisture content, to prevent piping and insure stability. (Salt Flats range site)

Penistaja Series

The Penistaja series consists of moderately deep and deep, mainly nearly level to strongly sloping soils on mesas mantled with eolian material.

The surface layer of these soils has a -inch dispersed crust. It consists of light-brown fine sandy loam, very fine sandy loam, or loam. This layer has a weak, medium, platy structure and a very friable consistence. It is free of lime.

The subsoil contains lime and becomes more compact with depth. The upper part is light reddish-brown clay loam of moderate, medium, blocky structure. The lower part is light reddish-brown, weakly calcareous sandy clay loam or clay loam of moderate, medium, blocky structure. The subsoil is finer textured on the milder slopes.

The underlying material is calcareous sandy loam. It is underlain at various depths by sandstone or sandy shale. Although firm, this layer is easily penetrated by roots.

Penistaja soils are well drained. Internal drainage is medium, permeability is moderate, and the water-holding capacity is high. Wind erosion and water erosion are only slight hazards where the vegetative cover is good.

The vegetation is mostly grass, but there are some scattered pinyon and juniper trees, which can be used for firewood and fenceposts.

Penistaja fine sandy loam, 0 to 5 percent slopes (Pf).—This soil occurs mainly in the northwestern part of the survey Area. It has medium runoff and is slightly eroded.

The surface layer is about 3 inches thick. The subsoil, about 30 inches thick, consists of clay loam or sandy clay loam. It is limy at a depth of 17 to 21 inches.

Included in mapping were a few small areas of Penistaja fine sandy loam, 5 to 9 percent slopes, and minor areas of Slickspots.

Brush clearing, reseeding, and chiseling are especially effective on this Penistaja soil. Forage plants respond well to deferment of grazing and rotation of grazing. Earthen structures are stable if the soil material is compacted at optimum moisture content. (Loamy Upland range site)

Penistaja fine sandy loam, 5 to 9 percent slopes (Pg).—This soil occurs as small, scattered tracts, mainly in the northwestern part of the survey Area. It has medium or rapid surface runoff and is slightly to moderately eroded. It is calcareous to the surface in places. All of this soil is in native range.

Included in the areas mapped were a few small tracts of Penistaja fine sandy loam, 0 to 5 percent slopes, and minor areas of Slickspots.

Chiseling, reseeding, and any other operations that disturb the soil should be done on the contour. Controlling erosion is the major problem. (Loamy Upland range site)

Penistaja-Berent association (Pn) (1 to 9 percent slopes).—This mapping unit is on fans and ridges in the western part of the survey Area.

Penistaja soils make up about 60 percent of the acreage. These soils are on side slopes. They are moderately deep and deep, well drained, and nearly level to strongly sloping. The vegetation consists of good stands of sagebrush, blue grama, and galleta.

Berent soils make up about 40 percent of this unit. These are deep and moderately deep, excessively drained, nearly level to strongly sloping soils on ridgetops and side slopes. They support fair stands of sagebrush, sand dropseed, and blue grama.

Included with these soils in mapping were nearly barren areas of Slickspots and minor areas of Shale outcrop and Sandstone outcrop.

(Penistaja—Loamy Upland range site; Berent—Deep Sand range site)

Penistaja-Sandstone outcrop association (Po) (1 to 25 percent slopes).—This mapping unit is mainly in the northwestern part of the survey Area.

Penistaja soils make up about 75 percent of the acreage. These soils are on side slopes. They are moderately deep and deep, well drained, and nearly level to strongly sloping. The vegetation consists of good stands of pinyon and juniper with blue grama and galleta as an understory.

Sandstone outcrop makes up about 25 percent of this unit. The outcrops themselves are bare, but between outcrops are small pockets of shallow soils on which pinyon and juniper grow.

(Penistaja—Loamy Upland range site; Sandstone outcrop—Sandstone Breaks range site)

Persayo Series

The Persayo series consists of shallow and very shallow, light-colored, moderately steep and steep soils on shale knobs and knolls scattered throughout the survey Area.

The surface layer of these soils ranges from loam to silty clay loam in texture, is light yellowish brown in color, and contains much free lime. This layer is friable. It is almost massive but shows some evidence of a weak platy structure.

The subsoil is light olive brown in color and ranges from loam to clay loam or silty clay loam in texture. It contains many gypsum crystals. The structure is weak, coarse, subangular blocky.

The underlying material is gray and olive, calcareous clay shale. Plant roots cannot penetrate this layer.

Persayo soils are well drained. Internal drainage is medium, and permeability is moderate to slow. The water-holding capacity is limited because of the shallowness to shale. Both wind erosion and water erosion are severe hazards.

These soils are in native grass.

Persayo gravelly soils-Shale outcrop association (Pr) (9 to 25 percent slopes).—This mapping unit occurs as small, scattered tracts on strongly sloping and moderately steep knolls and ridges. It is mainly in the southern part of the survey Area. Surface runoff is medium. The gravel increases the rate of water intake and helps to control erosion. The vegetation is native grass.

The gravelly surface layer of the Persayo soil in this unit is 2 to 4 inches thick. In places this layer is high in gypsum content. About 25 percent of the acreage consists of Shale outcrop.

Included in the areas mapped as this unit are a few small areas of the nongravelly Persayo-Shale outcrop association.

No mechanical conservation measures are feasible. Rock and brush dams could be built in some places for control of erosion. (Persayo—Gravelly Upland range site; Shale outcrop—Shale Breaks range site)

Persayo-Shale outcrop association (Ps) (9 to 25 percent slopes).—This mapping unit occurs as small tracts scattered throughout the survey Area. It is commonly associated with Litle and Las Lucas soils. Surface runoff is rapid, and consequently shallow gullies and rivulets are numerous. The vegetation is native grass.

Shale outcrop makes up about 25 percent of this association.

The surface layer of the Persayo soil in this association consists of loam and is about 3 inches thick. The

subsoil consists of clay loam or silty clay loam and is about 3 inches thick. The depth to shale is 6 to 16 inches.

Included in the areas mapped are a few small tracts of Litle silty clay loam on slopes of 1 to 5 percent and of Persayo gravelly soils-Shale outcrop association.

Risk of erosion, slow intake of water, and low water-holding capacity are the main limitations. Brush and rock dams could be used in some locations for control of erosion. The soil material is too shallow to permit the building of earthen structures. (Persayo—Shale Hills range site; Shale outcrop—Shale Breaks range site)

Prewitt Series

The Prewitt series consists of deep, moderately dark colored, nearly level and gently sloping soils on flood plains and terraces in the northeastern part of the survey Area. These soils are very mildly saline.

The surface layer ranges from sandy loam or silt loam to sandy clay loam in texture. This layer is reddish brown, contains some free lime, and is easy to work. The upper part has a granular structure, and the lower part a weak blocky structure.

The subsoil commonly is reddish-brown loam, but it ranges to silt loam, gritty loam, and gritty clay loam. The structure is weak, medium, subangular blocky. This layer contains a few calcium sulfate crystals.

The underlying material was deposited by water. It is stratified and contains much lime. It is easily penetrated by plant roots.

Prewitt soils are well drained. Internal drainage is medium, permeability is moderate, and the water-holding capacity is high. Natural fertility is low. Gully erosion is severe.

These soils are mainly in grass. Small acreages are irrigated and are used most commonly for small grain. A shortage of water has caused some irrigated areas to be abandoned.

Prewitt loam and Gullied land (Pw) (0 to 3 percent slopes).—This mapping unit occurs as small tracts, mainly in the northeastern part of the survey Area. Surface runoff is medium. The areas are severely eroded and have many vertical-walled gullies 10 to 40 feet deep.

The surface layer of the Prewitt soil in this unit is about 9 inches thick. The subsoil consists of loam, silt loam, or clay loam and is about 10 inches thick.

Included in mapping were a few small areas of Navajo clay and Gullied land.

Controlling water erosion is the major problem. The soil material erodes easily but is fairly stable if compacted at optimum moisture content. Water spreading, brush control, and reseeding would help to increase forage production in some areas. (Loamy Upland range site)

Ravola Series

The Ravola series consists of deep, light-colored, gently sloping to strongly sloping soils on flood plains and terraces. These soils are scattered throughout the survey Area.

The surface layer is light brownish gray and ranges from silty clay loam to light clay. The structure is granular. This layer contains some free lime.

The subsoil is light olive brown and is structureless. Both the subsoil and the substratum consist of stratified loam and sandy loam deposited by streams that flowed from areas underlain by alkaline shale and sandstone.

The substratum contains some free lime and is easily penetrated by plant roots.

Ravola soils are well drained. Internal drainage is medium, and permeability is moderate. Erosion is a severe hazard.

The vegetation is native grass.

Ravola silty clay loam and Gullied land (Rg) (0 to 5 percent slopes).—This mapping unit occurs as small, scattered tracts throughout the survey Area. It is along intermittent drainageways. Surface runoff is rapid. There are many active gullies 2 to 5 feet deep and a few that are 10 to 40 feet deep. Piping and sloughing are common.

The surface layer of the Ravola soil is about 10 inches thick. The subsoil and substratum consist of loam with lenses of sandy loam.

Included with this unit in mapping were a few small areas of Ravola silty clay loam, alkali, and Gullied land and minor areas of Billings silty clay loam and Gullied land.

The erosion hazard and slow intake of water are major limitations. Conservation needs include brush clearing, ripping, chiseling, and reseeding. Water spreading and the construction of erosion-control dams would help to stabilize the gullies. Earthen structures are fairly stable if the soil is compacted at optimum moisture content. (Clayey Upland range site)

Ravola silty clay loam, alkali, and Gullied land (Rk) (0 to 5 percent slopes).—This mapping unit is along intermittent drainageways throughout the survey Area. Surface runoff is very rapid. There are many gullies 2 to 5 feet deep and a few active gullies 10 to 40 feet deep. Slickspots are common, and the content of sodium salts is high.

Included in mapping were a few small areas of Ravola silty clay loam and Gullied land and minor areas of Billings silty clay loam, alkali, and Gullied land.

The erosion hazard, the concentration of sodium salts, and slow intake of water are the major limitations. Brush and rock dams would help to control gullying. Brush clearing, ripping, and reseeding are feasible for some sites. Because of the concentration of sodium salts, on-site investigations are necessary before earthwork is begun, and earthen structures must be specially designed. (Salt Flats range site)

Rock Outcrop-Travessilla-Persayo Association

Rock outcrop-Travessilla-Persayo association (Rt) is severely eroded. The slope range is 9 to 25 percent. Runoff is rapid or very rapid.

Moderately steep to nearly vertical outcrops of sandstone and shale make up about 50 percent of this association. Shallow, well-drained Travessilla soils, which are underlain by sandstone, make up about 25 percent; very shallow, well-drained Persayo soils, which are underlain by shale, make up about 20 percent; and nearly level to strongly sloping Billings soils, which occur along intermittent drainageways, make up about 5 percent.

The vegetation consists mostly of blue grama, galleta, alkali sacaton, and scattered pinyon and juniper trees. The cover is sparse, but most parts of the association provide food and cover for wildlife and some grazing for livestock. The rock outcrops are bare.

Brush and rock dams could be built in some areas. The soils are so shallow that mechanical measures for conservation are not feasible. (Rock outcrop—Shale Breaks range site; Travessilla—Shallow Upland range site; Persayo—Shale Hills range site)

Sandstone Outcrop-Travessilla Association

Sandstone outcrop-Travessilla association (St) occurs throughout the survey Area. It is on the tops of mesas, 200 feet above the general level of the terrain, and on breaks and escarpments. The slope range is 9 to 25 percent. The mesas are cut by intermittent drainageways.

Moderately steep to nearly vertical outcrops of sandstone make up 40 to 60 percent of this association. These outcrops occur on the fronts of the mesas and on the steep slopes along the drainageways. Shallow, strongly sloping Travessilla soils make up about 50 percent of the association. These soils are on the tops of the mesas. They range from fine sandy loam to loamy fine sand in texture and generally are calcareous. The vegetation consists of scattered ponderosa pine, pinyon, and juniper trees.

Rock and brush dams could be built in some areas. Other conservation measures are not feasible. (Sandstone outcrop—Sandstone Breaks range site; Travessilla—Shallow Upland range site)

Shavano Series

The Shavano series consists of moderately deep, light-colored, gently sloping to strongly sloping soils on upland ridges.

The surface layer of these soils consists of pale-brown fine sandy loam to loamy sand and contains free lime. This layer is platy and very friable.

The subsoil is brown, calcareous fine sandy loam to heavy loam of blocky structure. It is friable in the upper part and compact in the lower part.

The underlying material was weathered from interbedded sandstone and shale. It is sandy and contains much lime. The depth to sandstone ranges from 20 to 40 inches.

Shavano soils are well drained. Internal drainage is medium, permeability is moderate, and the water-holding capacity is high. Both wind erosion and water erosion are hazards.

These soils are in native grass. In the Cabezon Area, they are mapped only as part of an association with Berent soils.

Shavano-Berent association (Sv) (1 to 9 percent slopes).—This association occurs on upland hills and ridges in the southwestern part of the survey Area.

Shavano soils make up about 60 percent of the association. These are moderately deep, gently sloping to strongly sloping soils that support fair to good stands of blue grama and galleta.

Berent soils make up about 25 percent of the association. These are deep and moderately deep, nearly level to strongly sloping, somewhat hummocky soils that support sparse stands of sand dropseed, blue grama, and browse plants.

Sandstone outcrop, Shale outcrop, and nearly level areas of very shallow, dispersed clay (blowouts) make up about 15 percent of the association. (Shavano—Loamy Upland range site; Berent—Deep Sand range site)

Slickspots

Slickspots are areas where the soil material is so strongly alkali and so dispersed that the surface has sealed over. Slickspots in this survey Area consist of deep, light-colored soil. They occur on alluvial fans, mostly in the northern part of the Area. The surface layer of these spots ranges from loamy fine sand to fine sandy loam in texture and commonly is about 4 inches thick. It is light brownish gray and free of lime. It has a weak granular structure and a very friable consistence.

The subsoil is about 6 inches thick. It is grayish brown and ranges from sandy clay loam or clay loam to light clay in texture. It is free of lime but is high in sodium salts. The structure is coarse prismatic or columnar.

The underlying material is stratified clay loam and sandy loam that is easily penetrated by roots. This material contains little or no lime.

Slickspots have very rapid runoff, a low rate of water intake, slow internal drainage, and a high water-holding capacity. Wind erosion and piping are hazards. Ripping or chiseling would increase the intake rate and would help to slow runoff.

Slickspots were mapped in this Area only as part of Fruitland-Slickspot association, but some occur as inclusions in areas of other soils. All of the acreage is in native grass.

Torreon Series

The Torreon series consists of deep, dark-colored, nearly level and gently sloping soils on basalt-capped mesas in the southwestern corner of the survey Area.

The surface layer of these soils is brown in color, ranges from loam to light clay loam in texture, and is free of lime. It has a granular structure and a very friable consistence. Slight depressions occur in which the surface layer is thicker and contains more organic matter than is typical.

The upper part of the subsoil is brown clay loam of strong, fine, blocky structure. The lower part is more compact and consists of brown clay of moderate, medium, prismatic structure that breaks to strong blocky.

Below a depth of about 30 inches is calcareous brown clay to clay loam that is easily penetrated by roots.

Torreon soils are well drained. Internal drainage is medium, permeability is slow, and the water-holding capacity is high. Natural fertility is high. Erosion is only a slight hazard.

The vegetation consists of native grass and scattered stands of pinyon, juniper, and ponderosa pine.

Torreon loam (To) (0 to 3 percent slopes).—This soil occurs as small tracts on Chivato Mesa, in the southwestern part of the survey Area. Surface runoff is medium; erosion is slight. The surface layer is about 8 inches thick. The subsoil, about 24 inches thick, ranges from heavy clay loam to clay. Lime occurs at a depth of about 30 inches.

Included in mapping were a few very small intermittent lakes. The soil at the bottom of these lakes is deep, dark-colored clay that has poor internal drainage.

In some areas of this soil, brush control and reseeding are practical. Earthen structures are stable if the soil is

compacted at optimum moisture content. (Mountain Grassland range site)

Travessilla Series

The Travessilla series consists of shallow, light-colored, strongly sloping and moderately steep soils on sandstone mesas and breaks. These soils are scattered throughout the survey Area.

The surface layer is light brownish gray in color, ranges from fine sandy loam to loamy sand in texture, and contains much lime. This layer has a fine granular structure and a very friable consistence.

The subsoil consists of grayish-brown, calcareous fine sandy loam of blocky structure.

The underlying material weathered from the underlying sandstone. This material is calcareous and sandy. The depth to sandstone is 6 to 16 inches.

Travessilla soils are well drained. Internal drainage is rapid, permeability is rapid, and the water-holding capacity is low. Both wind erosion and water erosion are hazards. Good management of the vegetation is the best means of controlling erosion. Rock and brush dams can be built in some areas. Mechanical measures are not feasible, because the soil is so shallow.

The vegetation is native grass.

In the Cabezon Area, Travessilla soils are mapped only as part of the Fronton-Travessilla-Persayo association, the Rock outcrop-Travessilla-Persayo association, the Sandstone outcrop-Travessilla association, and the Travessilla-Persayo-Billings association.

Travessilla-Persayo-Billings association (Tp) (3 to 25 percent slopes).—Travessilla and Persayo soils each make up about 30 percent of this mapping unit. These soils are shallow and very shallow, well drained, and strongly sloping to steep. They occur on upland plateaus, between drainageways and escarpments. Billings soils make up about 25 percent of the acreage. These are deep, light-colored, nearly level to strongly sloping soils on valley slopes and along intermittent drainageways. About 15 percent of the unit consists of steep to vertical outcrops of sandstone and shale.

These soils are used for native range. The vegetation consists of pinyon, juniper, and scattered ponderosa pine. (Travessilla—Shallow Upland range site; Persayo—Shale Hills range site; Billings—Clayey Upland range site)

Use and Management of the Soils

This section gives a brief history of the use of soils as cropland and an explanation of the capability classification of soils. It discusses in some detail the management of the soils as rangeland and the engineering properties of the soils, and comments briefly on the potential of the soils for the production of wood crops and on the distribution of wildlife.

History of Farming

Both dryfarming and irrigation farming have been practiced in the Cabezon Area, but less than 1 percent of the acreage is now farmed. The rest of the farmland has reverted to grass.

Between 1920 and 1940, dryfarming was practiced in the vicinity of Mesa Aguila. Beans and corn were grown successfully in some years. A number of small irrigated farms were established after 1860 along the Rio Puerco. These farms were abandoned, however, when the adjoining rangeland was overgrazed and sediment-laden flash floods deepened and widened the main channels of the river and made diversion of water for irrigation impossible.

Navajo Indians dryfarm corn and truck crops in two or three areas along drainageways that supply extra moisture through runoff and overflow. The dryfarmed areas are made up principally of Fruitland soils and Alluvial land. Irrigated crops, mainly small grain and pasture, are grown on a minor acreage of Prewitt loam. Water for irrigation comes from streams that originate in the mountains east of the Area and generally is available only early in spring.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

In the capability system, all kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I. Soils have few limitations that restrict their use.

Class II. Soils have moderate limitations that reduce the choice or plants or require moderate conservation practices.

Class III. Soils have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Class IV. Soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V. Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

All the soils of the Cabezon Area are in class VI, VII, or VIII.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, VIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use.

The subclasses used in the Cabezon Area are listed as follows:

Subclass VIe. Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Subclass VIs. Soils generally unsuited to cultivation and restricted for other uses by shallowness, limited moisture supply, or fine texture.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.

Subclass VIIs. Soils very severely limited by low moisture-holding capacity, stones, alkali, or other features.

Subclass VIIIs. Rock or soil material that has little potential for plants.

Capability Units are soil groups within the subclasses. All soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to be similar in productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, VIe-1 or VIIs-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the Cabezon Area, climatic zones (see page 18) have to be considered in deciding the capability classification of a soil. Most of the soils are to be found in two climatic zones, and several have a different capability classification for each zone.

Table 2 shows, by climatic zone, the capability classification of each mapping unit in this Area. The capability units in this Area are defined as follows.

Table 2.—*Capability classification of soils, by climatic zones*

	Mapping unit	Capability unit		
		Climatic zone 4	Climatic zone 5	Climatic zone 6
Ak	Alkali alluvial land		VIIes-1	VIIes-1.
Au	Alluvial land		VIe-1	VIe-2.
Ba	Badland		VIIIs-1	VIIIs-1.
Bc	Basalt outcrop-Cabezon association:			
	Basalt outcrop	VIIs-1 or VIIIs-1		VIIs-1 or VIIIs-1.
	Cabezon soil	VIs-1		
Bd	Berent loamy fine sand, 0 to 5 percent slopes		VIe-5	VIe-5.
Be	Berent loamy fine sand, 5 to 9 percent slopes		VIe-5	VIe-5.
Bf	Berent-Sandstone outcrop association:			
	Berent soil		VIe-5	VIe-5.
	Sandstone outcrop		VIIs-3 or VIIIs-1	VIIs-3 or VIIIs-1.
Bg	Billings silty clay loam and Gullied land		VIe-3	VIe-4.
Bk	Billings silty clay loam, alkali, and Gullied land		VIIes-1	VIIes-1.
Bp	Billings and Persayo silty clay loams:			
	Billings soil		VIe-3	VIe-4.
	Persayo soil		VIIs-2	VIIs-2.
Cb	Cabezon-Basalt outcrop association:			
	Cabezon soil	VIs-1		
	Basalt outcrop	VIIs-4 or VIIIs-1		
Cg	Christianburg clay and Gullied land		VIIes-1	VIIes-1.
Fp	Fronton-Travessilla-Persayo association:			
	Fronton soil		VIIs-5	VIIs-5.
	Travessilla soil		VIIs-6	VIIs-6.
	Persayo soil		VIIs-2	VIIs-2.
Fr	Fruitland sandy loam		VIe-1	VIe-2.
Fs	Fruitland-Slickspot association:			
	Fruitland soil		VIe-1	VIe-2.
	Slickspot		VIIes-1	VIIes-1.
Lc	Las Lucas loam, 0 to 5 percent slopes		VIe-1	VIe-2.
Ld	Las Lucas loam, 5 to 9 percent slopes		VIe-1	VIe-2.
Le	Las Lucas soils, 5 to 9 percent slopes		VIe-3	VIe-4.
Lp	Las Lucas-Persayo association:			
	Las Lucas soil		VIe-1	VIe-2.
	Persayo soil		VIIs-2	VIIs-2.
Lr	Litle silty clay, 1 to 5 percent slopes		VIe-3	VIe-4.

TABLE 2.—*Capabilty classification of soils, by climatic zones*—Continued

	Mapping unit	Capability unit		
		Climatic zone 4	Climatic zone 5	Climatic zone 6
Ls	Litle silty clay, 5 to 9 percent slopes		VIe-3	VIe-4.
Lt	Litle-Las Lucas-Persayo association:			
	Litle soil		VIe-3	VIe-4.
	Las Lucas soil		VIe-1	VIe-2.
	Persayo soil		VIIs-2	VIIs-2.
Lu	Litle-Persayo association:			
	Litle soil		VIe-3	VIe-4.
	Persayo soil		VIIs-2	VIIs-2.
Ng	Navajo clay and Gullied land		VIIes-1	VIIes-1.
Pf	Penistaja fine sandy loam, 0 to 5 percent slopes		VIe-1	VIe-2.
Pg	Penistaja fine sandy loam, 5 to 9 percent slopes		VIe-1	VIe-2.
Pn	Penistaja-Berent association:			
	Penistaja soil		VIe-1	VIe-2.
	Berent soil		VIe-5	VIe-5.
Po	Penistaja-Sandstone outcrop association:			
	Penistaja soil		VIe-1	VIe-2.
	Sandstone outcrop		VIIs-3 or VIIIs-1	VIIs-3 or VIIIs-1.
Pr	Persayo gravelly soils-Shale outcrop association:			
	Persayo soil		VIIs-5	VIIs-5.
	Shale outcrop		VIIs-7 or VIIIs-1	VIIs-7 or VIIIs-1.
Ps	Persayo-Shale outcrop association:			
	Persayo soil		VIIs-2	VIIs-2.
	Shale outcrop		VIIs-7 or VIIIs-1	VIIs-7 or VIIIs-1.
Pw	Prewitt loam and Gullied land		VIe-1	VIe-2.
Rg	Ravola silty clay loam and Gullied land		VIe-3	VIe-4.
Rk	Ravola silty clay loam, alkali, and Gullied land		VIIes-1	VIIes-1.
Rt	Rock outcrop-Travessilla-Persayo association:			
	Rock outcrop		VIIs-7 or VIIIs-1	VIIs-7 or VIIIs-1.
	Travessilla soil		VIIs-6	VIIs-6.
	Persayo soil		VIIs-2	VIIs-2.
St	Sandstone outcrop-Travessilla association:			
	Sandstone outcrop		VIIs-3 or VIIIs-1	VIIs-3 or VIIIs-1.
	Travessilla soil		VIIs-6	VIIs-6.
Sv	Shavano-Berent association:			
	Shavano soil		VIe-1	VIe-2.
	Berent soil		VIe-5	VIe-5.
To	Torreon loam	VIs-2		
Tp	Travessilla-Persayo-Billings association:			
	Travessilla soil		VIIs-6	VIIs-6.
	Persayo soil		VIIs-2	VIIs-2.
	Billings soil		VIe-3	VIe-4.

Capability unit VIe-1. Nearly level to strongly sloping, well-drained soils on uplands; good moisture supply in winter.

Capability unit VIe-2. Nearly level to strongly sloping, well-drained soils on uplands; deficient moisture supply in winter.

Capability unit VIe-3. Nearly level to strongly sloping, moderately permeable soils on uplands; good moisture supply in winter.

Capability unit VIe-4. Nearly level to strongly sloping, slowly permeable soils on uplands; deficient moisture supply in winter.

Capability unit VIe-5. Nearly level to strongly sloping, somewhat excessively drained soils on uplands.

Capability unit VIs-1. Moderately steep, well-drained, shallow to moderately deep soils.

Capability unit VIs-2. Nearly level and gently sloping, slowly permeable, medium-textured soils.

Capability unit VIIes-1. Nearly level to sloping, severely eroded, strongly alkaline soils.

Capability unit VIIs-1. Steep and moderately steep, mainly very shallow, stony soils; elevation between 6,500 and 8,000 feet.

Capability unit VIIs-2. Hilly, shallow and very shallow soils underlain primarily by shale.

Capability unit VIIs-3. Gently sloping to very steep, mainly shallow and very shallow soils over sandstone.

Capability unit VIIs-4. Moderately steep to very steep, mainly shallow and very shallow, stony soils; at lower elevations than soils in capability unit VIIs-1.

Capability unit VIIs-5. Nearly level to steep, shallow to moderately deep, gravelly soils.

Capability unit VIIs-6. Gently sloping to steep, shallow soils over sandstone.

Capability unit VIIs-7. Moderately steep to very steep, shallow soils over shale.

Capability unit VIIIs-1. Steep to very steep, nearly barren or barren outcrops of shale, sandstone, or basalt.

Range Management [1]

The Cabezon Area is mainly rangeland. Most of it can be grazed the year round, since the winters generally are open, and accumulated snow remains on the ground for only short periods. The highest parts of the Area, which are in the extreme southwestern corner and along the northeastern boundary, are grazed only in summer.

Livestock operations range from small flocks of sheep owned by itinerant Navajo Indians to fair-sized cow-calf-yearling operations. The ranches range in size from a few acres, operated as subsistence stock farms, to several sections. Few units carry more than 100 head of cattle the year round.

General management practices

Good range management increases production of the best native forage plants and conserves soil and water. Practices needed in the Cabezon Area include the following:

Limitation of grazing.—This is of primary importance. Without it, all other practices are ineffective. Most of the nutrients that plants need in order to grow, flower, and reproduce are manufactured in the foliage. Livestock seek out the most palatable plants first. If they eat more than half the yearly growth, these plants cannot compete successfully with the less desirable plants, and the range deteriorates. Vegetation left on the surface increases the water-intake rate, improves the water-holding capacity, and helps to control erosion. Overgrazing is particularly harmful to sandy soils and to shallow soils.

Deferment of grazing.—The practice of excluding livestock from native grassland during all or part of a growing season gives desirable plants a chance to grow, seed, and spread. Some soils respond to this practice more quickly than others. Sandy and gravelly soils show more improvement after 1 year of rest than loamy and clayey soils.

Rotation of grazing.—Alternately resting and grazing parts of a range through a growing season gives the vegetation in all parts a chance to reseed.

Fencing.—Fencing the range into effective management units makes it easier to keep livestock evenly distributed. Fences should follow soil boundaries or range-site boundaries, so that areas of different potential will be separated.

Seeding.—Seeding with the native species increases the yield of herbage and helps to control erosion and conserve moisture. To create an environment favorable for new grass seedlings, it generally is necessary to eliminate the low-value native plants and to grow one cover crop. Seeding is difficult in the Cabezon Area, because of the dry climate. It is most effective on the medium-textured and coarse-textured soils. It is not effective on the very shallow soils.

Brush control.—Eliminating or suppressing pinyon, juniper, big sagebrush (*4*)[2], rabbitbrush, and other unwanted plants makes more moisture available for the useful plants. Brush control is practical where the soils are medium textured, deep or moderately deep, and nearly level or gently sloping. Sandy soils, steep soils, and unproductive soils are susceptible to erosion if cleared.

Water development.—An ample supply of good-quality water at suitable locations helps to keep livestock evenly distributed over the range. In many parts of the Cabezon Area, the supply of water from existing wells, springs, or ponds is not adequate. Seeps and springs in areas of Basalt outcrop have some potential for further development.

Water spreading.—This practice is regulated by State law. It involves diverting runoff from natural channels or gullies and spreading it over nearly level areas. Earthen diversions, net wire diversions, and rock and brush dams have been used. Water spreading is most effective where the soils are deep enough to hold a large amount of water and where the surface texture is such that water is absorbed quickly.

Contour furrowing and pitting.—Both of these practices help to control runoff and floodwater and thereby to control erosion and increase infiltration. These practices are most effective on the deep, fine-textured soils. Contour furrowing is more effective than pitting.

Range sites and condition classes

Range managers need to know which plants are likely to grow best on a particular site. The kinds and amounts of herbage produced on each site depend mainly on the combined effects of the soils and the climate.

New Mexico is divided into numbered climatic zones. Only zones 4, 5, and 6 are represented in the Cabezon Area (fig. 7). Zone 4 is in the mountains; zones 5 and 6 are on the plateaus and mesas. The differences in climate are enough to influence the kind and amount of vegetation. Zone 5, for example, receives considerably more precipitation in winter than zone 6, and big sagebrush, which responds well to winter moisture, is more common in zone 5.

Range plants are classified as decreasers, increasers, and invaders. Decreasers are the plants most palatable to livestock, and they are sensitive indicators of overgrazing. Unless grazing is carefully regulated, these plants die out and are replaced by increasers, which ordinarily are less palatable than the decreasers. If the range condition continues to decline from overuse, the increasers also die out and, in turn, are replaced by invaders. Invaders are plants not present in the original vegetation.

Range condition is judged on the basis of the percentage of the original vegetation remaining. A range is in excellent condition if the percentage is between 76 and 100, in good condition if the percentage is between 51 and 75, in fair condition if the percentage is between 26 and 50, and in poor condition if the percentage is 25 or less.

Descriptions of range sites

The soils of the Cabezon Area have been grouped into 15 range sites, which are described in the following paragraphs. In each description are shown important soil characteristics, principal plants, estimates of yields, and suggestions for management. The estimates of yields represent grasses, forbs, and browse.

To find the range site in which each soil has been placed, and the page on which it is described, turn to the "Guide to Mapping Units," near the back of this soil survey.

LOAMY UPLAND RANGE SITE, ZONE 5

The soils of this site have a surface layer of fine sandy loam, sandy loam, or loam. They are moderately deep to deep, nearly level to strongly sloping soils on uplands. They take in water at a moderate rate and have moderate

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[1] This section was prepared by A. V. Steed, range conservationist, Soil Conservation Service.

[2] Italic numbers in parentheses refer to Literature Cited, p. 43

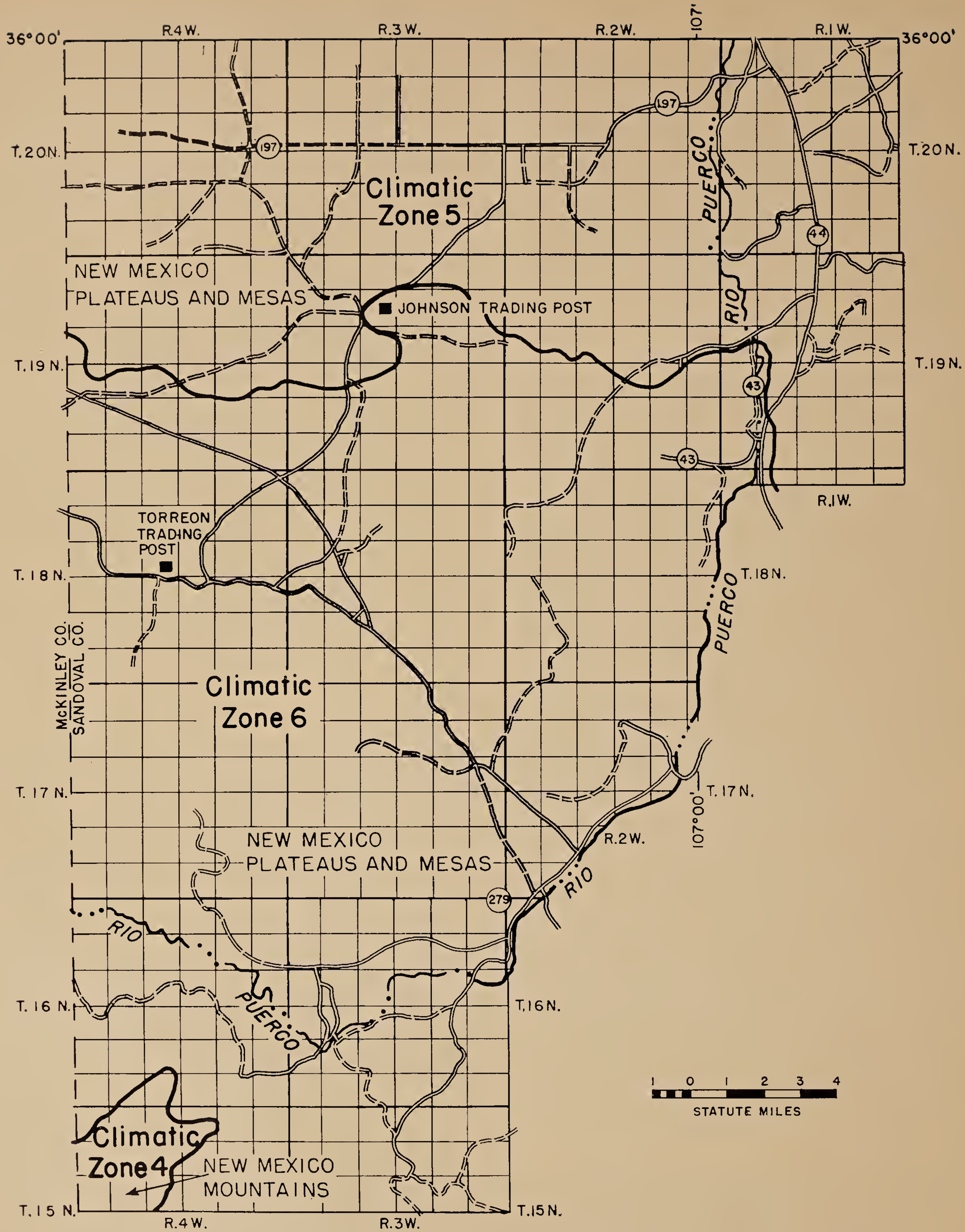

Figure 7.—**Climatic zones represented in the Cabezon Area.**

to high water-holding capacity. Overflow from natural drainageways contributes little moisture.

This site is in the northern and northwestern parts of the Area. The typical vegetation is a grass-sagebrush mixture.

The principal decreaser plants are blue grama, western wheatgrass, Indian ricegrass, galleta, and winterfat. Major increasers include big sagebrush, three-awn, ring muhly, rabbitbrush, broom snakeweed, and longleaf ephedra. Pinyon, juniper, pingue (Actinea), locoweed, and lupine are invaders.

Big sagebrush is probably the most important increaser (fig. 8). It should not make up more than 20 percent of the total herbage.

Figure 8.—**In the foreground, an area of the Loamy Upland range site, zone 5, in poor condition. The big sagebrush shows the need for brush control. In the background, areas of the Sandstone Breaks and Shale Breaks range sites.**

The relative proportions of grass and sagebrush depend on grazing management and on the weather. Sagebrush and woody invaders increase if the grasses are moderately overgrazed. Light summer rains are utilized better by grasses and forbs; winter moisture stored in the soil is of more benefit to the sagebrush and other shrubs.

The total yield from this site varies, but it normally is about 1,000 pounds per acre, air-dry weight.

Effective measures for improving this site are brush control, range seeding, water spreading, and erosion control. The important forage species respond favorably to deferment of grazing and to rotation of grazing.

LOAMY UPLAND RANGE SITE, ZONE 6

The soils of this site have a surface layer of sandy loam or fine sandy loam to loam. They are moderately deep and deep, nearly level to strongly sloping soils on the slopes between the steep hills or breaks and the bottom lands. The elevation generally is less than 6,700 feet. The rate of water intake is moderate, and the water-holding capacity is moderate to high. Light showers are less effective than on the Deep Sand and the Sandstone Breaks range sites but more effective than on either of the Clayey Upland range sites.

This site is in the southern part of the survey Area. The vegetation consists mainly of grasses and typically does not include big sagebrush.

About 50 percent of the plants are decreasers, among them galleta, blue grama, western wheatgrass, and Indian ricegrass. As much as 10 percent is sand dropseed, mesa dropseed, and spike dropseed. Winterfat and fourwing saltbush make up a small percentage, even where the site is in good or excellent condition, and there are scattered areas of three-awn, ring muhly, and unpalatable shrubs, including rabbitbrush and ephedra. Scrubby pinyon and juniper are invaders.

If this site is in excellent condition, the total annual yield of herbage is about 750 pounds per acre, air-dry weight.

Applicable conservation measures include the deferment or rotation of grazing, development of a water supply, brush control, seeding, water spreading, contour furrowing, and erosion control.

DEEP SAND RANGE SITE, ZONES 5 AND 6

The soils of this range site have a surface layer of loamy fine sand and a subsoil of loamy sand. They are deep, nearly level to strongly sloping soils, generally at the base of sandstone outcrops or on sandstone-capped mesas. The rate of water intake is rapid, and the water-holding capacity is low to moderate. Runoff causes some gullying, and wind erosion also is a hazard. Small dunes have formed and could spread unless this site is well managed.

The typical vegetation on this site consists of pinyon and juniper trees and an understory of grasses, forbs, and shrubs.

The principal decreaser plants include blue grama, Indian ricegrass, galleta, needle-and-thread, New Mexico needlegrass, and western wheatgrass. Major increasers are three-awn, ring muhly, sand sagebrush, big sagebrush, broom snakeweed, sandhill muhly, longleaf ephedra, and dropseeds (fig. 9).

Figure 9.—**An area of the Deep Sand range site in fair condition. Big sagebrush and other increaser plants make up a high percentage of the vegetation.**

Tall bunch grasses are common if this site is in good or excellent condition. If the site is allowed to deteriorate, these plants gradually disappear and are replaced by increasers, such as sand dropseed, three-awn, ring muhly, and shrubby sage. Pinyon and juniper may take over completely in a seriously deteriorated area.

If this site is in excellent condition, the total annual yield normally is about 1,150 pounds per acre, air-dry weight. Productivity is high even in years when the moisture supply is below normal, since the soils take in moisture rapidly and release it readily to plants.

Range seeding is practical except where dunes have formed. Brush can be used to stabilize small gullies. Brush removal is likely to leave an area open to wind erosion, unless there is a good cover of herbaceous vegetation. Pitting and contour furrowing are not practical.

This site is a good source of firewood, fence posts, and stay material. Pinyon nuts can be harvested in some years.

CLAYEY UPLAND RANGE SITE, ZONE 5

The soils of this site have a surface layer of clay loam, silty clay loam, or silty clay that cracks and crusts readily. The subsoil is fine textured and in places contains gypsum. These soils are moderately deep or deep and nearly level

to strongly sloping. They take in water at a moderate rate until they begin to seal over. The water-holding capacity is high, and moisture that falls in winter is retained in the soils well into spring.

This site is dissected by shallow rivulets, which could develop into deep, vertical-walled gullies. Overflow from these rivulets contributes little moisture. Intermingled with this Clayey Upland range site are small areas of the Shale Hills and the Shale Breaks range sites.

Typically, this site has a cover of grasses and shrubs, mainly galleta, alkali sacaton, western wheatgrass, Indian ricegrass, blue grama, big sagebrush, and winterfat. Shadscale and rabbitbrush occur in smaller amounts. Alkali sacaton is the major decreaser, and big sagebrush, three-awn, rubber rabbitbrush, and ring muhly are increasers. Pingue and fluffgrass are herbaceous invaders; pinyon and juniper are woody invaders.

If this site is in excellent condition, the total annual yield is about 1,100 pounds per acre, air-dry weight. This site is extensive and contributes a major amount of the forage produced in the Area. It is especially productive in wet years.

Applicable conservation practices include brush control, pitting, contour furrowing, range seeding, water spreading, and erosion control. Contour furrowing is more beneficial than pitting.

CLAYEY UPLAND RANGE SITE, ZONE 6

The soils of this site have a fine-textured surface layer. They are moderately deep or deep, nearly level to strongly sloping soils on the slopes between the Shale Breaks or the Shale Hills range sites and the Salt Flats range site. The elevation is less than 6,700 feet. These soils take in water slowly and have high water-holding capacity. During intense storms, runoff causes both sheet erosion and severe gully erosion, especially if the ground cover is thin. Wind erosion is a hazard where the vegetation is thin.

Decreasers make up about 55 percent of the vegetation on this site. They include alkali sacaton, western wheatgrass, Indian ricegrass, winterfat, and fourwing saltbush. Common increasers, including galleta, ring muhly, three-awn, rabbitbrush, and broom snakeweed, account for not more than 20 percent of the vegetation. Galleta, the major increaser, in some places accounts for as much as 25 percent of the cover. Pinyon and juniper are invaders.

Forage production is high in wet years. A total annual yield of 900 pounds per acre, air-dry weight, can be expected if the site is in excellent condition.

Deferment or rotation of grazing is a major need. Other measures that may be needed include water spreading, chiseling, contour furrowing, erosion control, brush control, and range seeding.

SHALLOW UPLAND RANGE SITE, ZONES 5 AND 6

The soils of this site are medium textured in the topmost few inches and are shallow and gently sloping to steep. They generally are underlain by sandstone at a depth of 12 inches or less. They take in water at a moderate rate and have low water-holding capacity (fig. 10).

The vegetation on this site consists mainly of blue grama, galleta, sand dropseed, spike dropseed, and scattered stands of pinyon and juniper. Scrubby ponderosa pines grow at the higher elevations. Indian ricegrass and little bluestem are decreasers. Alkali sacaton is present but is a minor plant. Among the increasers are broom

Figure 10.—An area of the Shallow Upland range site, showing exposed sandstone and a light cover of juniper.

snakeweed, rabbitbrush, ephedra, ring muhly, and three-awn. Pingue, locoweed, and whorled milkweed are invaders. Frequent light summer showers are utilized effectively on this site.

If this site is in excellent condition, the total annual yield normally is 450 pounds per acre, air-dry weight.

Deferment or rotation of grazing is about the only range-improvement practice that is feasible. Brush and rock dams would help to control erosion, but to only a limited extent.

GRAVELLY UPLAND RANGE SITE, ZONES 5 AND 6

The soils of this site have a gravelly loam surface layer and a moderately compact, fine-textured subsoil. They are on nearly level mesa tops and on steep hillsides. The soils are moderately shallow to deep; the depth to shale bedrock is less than 18 inches. Water intake is rapid, and the water-holding capacity is low. The gravel helps to protect the soils from erosion, and the erosion hazard is only slight.

The vegetation on this site consists of pinyon and juniper and an understory of grasses and shrubs. Blue grama, western wheatgrass, Indian ricegrass, and galleta are the major decreaser plants. They make up about 50 percent of the herbage. Scrubby ponderosa pines and other trees make up as much as 40 percent. Dropseed makes up as much as 10 percent. Three-awn, ring muhly, broom snakeweed, rabbitbrush, and species of *Chrysopsis* and *Senecio* are increasers. Big sagebrush invades and spreads if the site is moderately overgrazed. Locoweed, pingue, whorled milkweed, soapweed, and species of cactus also invade. Frequent light summer showers are utilized effectively by the vegetation on this site.

If this site is in excellent condition, the total annual yield normally is about 1,000 pounds per acre, air-dry weight.

Measures for improving this site include deferment and rotation of grazing. Brush control would increase forage production in some parts. Earth dams or brush and rock dams placed in drainageways would help to control erosion.

SHALE HILLS RANGE SITE, ZONES 5 AND 6

The soils of this site are predominantly silty clay loams. They are underlain mainly by shale but partly by strat-

ified shale and sandstone. Water intake is slow, and the water-holding capacity is low. The slope range is 9 to 25 percent, and the topography is hilly.

The vegetation is a mixture of grass, trees, shrubs, and scattered forbs. Trees grow where the soils are deepest and particularly where the underlying material includes sandstone. On the gentler slopes, the vegetation is dominantly grass. A few forbs are mixed with the grass, and trees occur as invaders.

Blue grama, alkali sacaton, western wheatgrass, littleseed ricegrass, Indian ricegrass, and needle-and-thread are the major decreaser grasses, and winterfat and fourwing saltbush are the major decreaser shrubs. Galleta, a major increaser, makes up as much as 25 percent of the herbage in some places. At the higher elevations, big sagebrush is the major increaser and makes up as much as 15 percent of the herbage. Three-awn, Thurber's muhly, sleepygrass, buckwheat, black sagebrush, ring muhly, and wiregrass also are increasers. Rabbitbrush, greasewood, and pingue are invaders.

These are good grassland soils. They are most productive in years when the winter moisture supply is good. Light showers during dry summers are not effective.

If this site is in excellent condition, the total annual yield normally is 950 pounds per acre, air-dry weight. Big sagebrush, three-awn, and ring muhly take over if the condition declines. Then woody plants invade, and pinyon and juniper gradually form a closed canopy.

Measures for improving this site include deferment or rotation of grazing, brush control, and range seeding. Salting and the development of water supplies would promote better distribution of livestock. Brush and rock dams would help to control erosion.

SHALE BREAKS RANGE SITE, ZONES 5 AND 6

Most of the soils of this range site have a silty clay loam surface layer that contains some salts and commonly is crusted. The soils vary in depth. Shale and sandstone crop out in places, and pockets of shallow soil material adjoin the outcrops. The slope range is 25 to 75 percent; the steepest parts consist of bare outcrops of shale that merge into wasteland. Water intake is slow, and the water-holding capacity varies. Runoff during intense showers is rapid, and rills and gullies are common.

Typically, this site has a cover of shrubs and grasses and a light overstory of pinyon and juniper. These trees make up as much as 20 percent of the vegetation. Alkali sacaton, galleta, Indian ricegrass, blue grama, and western wheatgrass are major decreaser grasses, and fourwing saltbush and winterfat are major decreaser shrubs. Rabbitbrush, Thurber's muhly, greasewood, three-awn, buckwheat, and black sagebrush are increasers. Pingue is an invader. This site has less grass and more shrubs than the Shale Hills range site.

The total annual yield generally does not exceed 200 pounds per acre, air-dry weight, even in favorable years.

This site is of little use for livestock and, at present, cannot be improved. If it is even moderately overgrazed, Indian ricegrass and other sensitive decreasers are replaced by less palatable grasses and by shrubs and trees.

SANDSTONE BREAKS RANGE SITE, ZONES 5 AND 6

The soils of this site have a sandy surface layer. They are mostly shallow or very shallow over sandstone, but there are some deeper pockets. Sandstone outcrops cover as much as 50 percent of the surface in some places. The slope range is 3 to 75 percent; a slope of 25 to 40 percent is most common. Water intake generally is rapid, and the water-holding capacity is low.

The vegetation on this site consists of a sparse cover of grasses and light scattered stands of pinyon and juniper. Major decreaser grasses include blue grama, Indian ricegrass, sideoats grama, needle-and-thread, galleta, western wheatgrass, and little bluestem. Fourwing saltbush is a major decreaser shrub. Sand dropseed makes up as much as 15 percent of the cover. Three-awn, spike muhly, ephedra, rabbitbrush, and cactus are increasers. Pinyon, juniper, and scrubby ponderosa pine grow at the higher elevations but make up not more than 15 percent of the cover. Frequent light summer showers are effectively utilized on this site.

The total annual yield normally is about 450 pounds per acre, air-dry weight.

If this site is grazed continuously, woody plants and the less palatable grasses increase as the more sensitive plants decrease. Consequently, grazing should be limited. Salting and the development of water supplies would promote better distribution of livestock. No other measures would be feasible. The potential for wildlife is high.

SALT FLATS RANGE SITE, ZONES 5 AND 6

The soils of this site have a surface layer of loam, silty clay loam, and clay. They are deep, strongly alkaline, nearly level to sloping soils on bottom lands and alluvial slopes along the major waterways. The salt content varies but is strong enough to affect the vegetation (fig. 11). Surface crusting is common. Water intake is very slow, but the water-holding capacity is high. Overflow from natural drainageways contributes little moisture. Erosion is a serious hazard where the vegetation has been depleted. Deep, vertical-walled gullies are common.

The vegetation on this site consists of grasses and scattered palatable shrubs. Alkali sacaton, the major decreaser, makes up more than 60 percent of the plant cover. Western wheatgrass and fourwing saltbush, which also are decreasers, grow in disturbed areas. Saltgrass, mat muhly, and red muhly are the principal increaser grasses, and greasewood and shadscale are increaser shrubs. Big sagebrush and rabbitbrush are minor increasers.

Figure 11.—**In the foreground, an area of the Salt Flats range site. In the background, an area of the Shale Breaks range site.**

When in excellent condition, this site has a dense grass cover. Greasewood, shadscale, and mat muhly increase if the site is moderately overgrazed. As the grass cover further declines and is partly replaced by shrubs, erosion accelerates and the drainageways cut gullies.

If this site is in excellent condition, the total annual yield ranges from 900 to 3,250 pounds per acre, air-dry weight. The average annual yield is about 1,800 pounds per acre in normal years.

Good management of grazing is essential on this site. Brush control and range seeding are possible in some areas. Brush and rock dams can be used to help control erosion, but no earthwork should be undertaken till after careful on-site investigations of the soils.

MALPAIS BREAKS RANGE SITE, ZONE 4

This site is made up of basalt escarpments and very shallow to moderately deep pockets of stony clay loam that takes in water rapidly but has low water-holding capacity. The slope is less than 75 percent, and the elevation is 6,500 to 8,000 feet.

The vegetation on this site consists of a light overstory of ponderosa pine and a low-density, mixed understory of grasses, forbs, and shrubs. Mountain muhly, little bluestem, muttongrass, western wheatgrass, prairie junegrass, and pine dropseed are major decreasers. Arizona fescue, blue grama, three-awn, and dropseed are common increasers. Gambel oak, pingue, broom snakeweed, Kentucky bluegrass, rabbitbrush, quaking aspen, pinyon, and juniper are invaders. Grasses make up at least 65 percent of the cover, and forbs a minor part. Shrubs and trees could become dominant.

Unless this range site adjoins more open and accessible sites, it has little potential except as woodland and wildlife habitat. So much of the surface is bare rock that yields of herbage are low. Even when this site is in excellent condition, the total annual yield normally is only about 500 pounds per acre, air-dry weight.

MALPAIS BREAKS RANGE SITE, ZONE 6

The soils of this site have a cover of various-sized stones, which help to retard erosion. As much as 20 percent of the acreage is wasteland, and about 20 percent consists of barren outcrops of basalt. The soils are mostly shallow and very shallow, but there are scattered pockets of moderately deep soil.

This range site is a transition zone between the plateaus and mesas and the mountains. The slope range is 9 to 75 percent, and slopes of about 40 percent predominate. The slopes are broken by small benches or terraces, plateaus, and drainageways.

Typically, the vegetation is a mixture of trees, shrubs, and grasses. Frequent light showers favor plant growth. The ground cover is thin and scattered. The trees, mainly pinyon and juniper, range in density from scattered individual trees to stands with a nearly closed canopy. Decreaser plants make up about 75 percent of the herbage, and woody plants about 10 percent. Blue grama, needle-and-thread, galleta, western wheatgrass, sideoats grama, Indian ricegrass, prairie junegrass, bottlebrush, squirreltail, pine dropseed, fourwing saltbush, mountain-mahogany and Apache-plume are major increaser plants. Three-awn, ring muhly, hairy tridens, wolfberry, oak, and sand dropseed are increasers. Whorled milkweed, broom snakeweed, and rabbitbrush are common invaders. Indian ricegrass and needle-and-thread disappear if the site is even moderately overgrazed.

The total annual yield normally is about 300 pounds per acre, air-dry weight.

The use of this site is limited by stones and steep slopes. Water supplies could be developed along drainageways and from springs and seeps. Most other management practices are not feasible. The potential for wildlife is high.

MOUNTAIN GRASSLAND RANGE SITE, ZONE 4

The soils of this site have a surface layer of friable loam that is noncalcareous and has granular structure. The organic-matter content of the topmost 6 inches is high. These are deep, nearly level and gently sloping soils in parklike areas on Chivato Mesa. They are underlain by basalt and volcanic debris. They take in water rapidly and have high water-holding capacity. The soils become shallower where this site adjoins the Malpais Breaks range site.

The vegetation consists of a uniform cover of grasses. A few scattered ponderosa pines give the site the appearance of a savanna. Mountain bunch grasses are dominant if the site is in excellent condition. Mountain muhly, pine dropseed, little bluestem, prairie junegrass, sideoats grama, mountain brome, and several kinds of forbs are decreasers. These plants make up more than 50 percent of the vegetation. Blue grama makes up as much as 20 percent. Arizona fescue, western wheatgrass, and sedges are increasers. The fescue makes up as much as 10 percent of the herbage; the wheatgrass spreads in disturbed areas. Rabbitbrush, Kentucky bluegrass, pinyon, and juniper are potential invaders.

If the condition of the range declines, the percentage of the more palatable bunch grasses tends to decrease and that of blue grama to increase. Rabbitbrush, fringed sage, and other woody plants also increase.

If this site is in excellent condition, the total annual yield normally can be expected to exceed 2,000 pounds per acre, air-dry weight.

Measures for improving this site include the deferment or rotation of grazing, range seeding, and brush control. Water supplies could be developed where the soils are deepest. The potential for wildlife and recreation is high.

PINE GRASSLAND RANGE SITE, ZONE 4

The soils of this site have a very friable surface layer that is free of lime and high in natural fertility. These are moderately steep, shallow to moderately deep soils underlain by basalt, volcanic debris, sandstone, or shale. Basaltic cobblestones and stones commonly crop out. The soils take in water at a moderate rate and have low water-holding capacity.

If this site is in excellent condition, the vegetation consists of a thin stand of ponderosa pine and a ground cover of mountain bunch grasses. Arizona fescue, mountain muhly, junegrass, and pine dropseed are decreaser plants. They make up 55 percent or more of the vegetation. Gambel oak, blue grama, and spike muhly, the major increasers, make up about 20 percent. Gambel oak increases after fires and could become the dominant plant. Pinyon, juniper, pingue, rabbitbrush, and Kentucky bluegrass are potential invaders.

If this site is in good condition, the total annual yield normally can be expected to exceed 2,000 pounds per acre, air-dry weight.

Measures for improvement include the deferment or rotation of grazing. Brush control and the laying out of stock trails should be considered. Development of water supplies is a problem. Water can be hauled, or it can be obtained from springs and pipelines. The potential for wildlife and recreation is high.

Woodland

Woodland covers about 1,000 acres, less than 0.3 percent of the Area. It consists mostly of ponderosa pine and a mixture of oakbrush, pinyon, and juniper. Most of it occurs in the Cabezon-Basalt outcrop association, on the rocky slopes and ridges of Chivato Mesa. The elevation is between 7,500 and 8,000 feet. The annual precipitation is about 17 inches.

The potential for wood crops is low. Much of the pine is only 45 to 50 feet tall at maturity, and regeneration is limited. There are only scattered clumps of young trees. About the only practical management consists of protecting the woodland from fire and from overgrazing.

Wildlife [3]

Most of the soils in the Cabezon Area provide suitable habitat for one or more kinds of wildlife. A few ponds have been stocked with fish.

Wildlife habitat can be correlated in a general way with the six soil associations, which are described in the section "General Soil Map."

A few North American pronghorn antelope live in all the associations except 4 and 5. They are most numerous in 1 and 6. They feed on Russian-thistle, rabbitbrush, chamiza, winterfat, big sagebrush, cactus, and nearly all native grasses.

Rocky Mountain mule deer live primarily in associations 3, 4, and 5, but at times they move into the other associations. The population of mule deer is most nearly stable on Chivato Mesa, in association 4. Browse plants in this association show evidence of overuse.

Blacktail jackrabbits, along with pocket mice, kangaroo mice, and kangaroo rats, live in association 6. Chipmunks, porcupines, several kinds of mice, and cottontail rabbits live in the lower foothills. Tasseleared squirrel and a very few black bear and elk live at the higher elevations. Coyotes and bobcats live in all parts of the Area and are a continuous threat to livestock.

Among the birds that nest at an elevation of 7,000 to 8,000 feet in associations 4 and 5 are horned larks, eastern meadowlarks, vesper sparrows, Merriam's turkeys, band-tailed pigeons, great horned owls, long-eared owls, woodpeckers, sapsuckers, violet-green swallows, purple martins, and western bluebirds. Golden eagles, prairie falcons, and common ravens nest on the honeycombed ledges and vertical walls of Chivato Mesa, in association 4.

During peak migration periods, mourning doves and scaled quail provide a little hunting throughout the Area.

Ponds suitable for stocking with fish have been developed mainly in associations 2 and 6. In the other associations water is obtained mostly from wells.

[3] This section was prepared by JOHN B. FARLEY, biologist, Soil Conservation Service.

Engineering Properties of the Soils [4]

This section of the soil survey provides information that is useful in conserving soil and water and in building roads, dams, and other structures. Engineers can use the information in this section to—

1. Make studies that will aid in the selection and development of industrial, business, residential, and recreational sites.
2. Make estimates of soil properties, erosion, runoff, and other characteristics for use in designing drainage systems and in planning dams, reservoirs, farm ponds, diversion terraces, and other structures needed to conserve soil and water.
3. Correlate performance of soils used as surfacing and foundation material and thus develop information that is useful in designing and maintaining roads, highways, airports, and buildings.
4. Locate gravel, sand, and other material suitable for use in construction.
5. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
6. Supplement information obtained from other published maps and reports and aerial photographs, for the purpose of making soil maps and reports that engineers can use readily.
7. Identify sites that may require special methods or specific designs for structures.

With the use of the soil map for identification, the engineering interpretations in this section can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and excavations deeper than the depths of layers here reported. Even in these situations, the soil map is useful in planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used by soil scientists may not be familiar to engineers, and some terms may have special meanings in soil science. These terms are defined in the Glossary at the back of this survey.

Engineering classification systems

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, consisting of clay soils having low strength when wet. Within each group the relative engineering value of the soil material is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses after the soil group symbol.

Many engineers prefer to use the Unified soil classification system (*8*). In this system soils are classified as coarse grained (eight classes), fine grained (six classes), and highly organic. If soils are on the borderline between two classifications, a joint classification is used, for example, ML–CL.

[4] RAUL A. RIVERA, engineer, Soil Conservation Service, assisted in writing this section.

Engineering test data

Table 3 presents data obtained by laboratory tests made by the New Mexico State Highway Commission. These tests were made according to standard procedures of the American Association of State Highway Officials (AASHO). Engineers find the data useful in determining the physical properties of the soils in the Cabezon Area and the condition of the soils in place.

The soils shown in table 3 were sampled at selected depths and in one or more locations. The engineering properties of a soil at one location are indicated by this test data, but there may be variations in the properties of this soil at other locations in the survey Area. Even for those soils sampled in more than one location, the test data probably do not show the maximum degree of variation in properties.

TABLE 3.—

[Tests performed by the New Mexico State Highway Commission, in accordance with

Soil name and location	Parent material	New Mexico report number	Depth
			Inches
Berent loamy fine sand, 0 to 5 percent slopes: NE. corner of sec. 27, T. 20 N., R. 4 W. (Modal)	Windblown material.	62–13151	0 to 6
		62–13152	11 to 18
		62–13153	34 to 60
SW¼NE¼ sec. 28, T. 20 N., R. 4 W. (Finer textured)	Windblown material.	62–13154	0 to 4
		62–13155	8 to 14
		62–13156	24 to 58
Billings silty clay loam and Gullied land (Billings part): SW¼SW¼ sec. 4, T. 19 N., R. 1 W. (Modal)	Alluvium.	62–13162	0 to 3
		62–13163	9 to 21
		62–13164	28 to 45
Billings silty clay loam, alkali, and Gullied land (Billings part): SW¼SE¼ sec. 34, T. 17 N., R. 3 W.	Alluvium.	62–13172	0 to 6
		62–13173	17 to 34
Christianburg clay and Gullied land (Christianburg part): SW¼SW¼ sec. 7, T. 20 N., R. 1 W. (Modal)	Alluvium.	62–13184	0 to 34
Fruitland sandy loam: 0.125 mile S. of center of sec. 11, T. 20 N., R. 2 W. (Modal)	Alluvium.	62–13139	0 to 4
		62–13140	4 to 10
		62–13141	18 to 40
NE¼NE¼ sec. 23, T. 20 N., R. 3 W. (Deeper)	Alluvium.	62–13145	0 to 4
		62–13146	7 to 16
		62–13147	30 to 47
Fruitland-Slickspot association (Slickspot part): SE¼SE¼ sec. 11, T. 20 N., R. 2 W.	Alluvium.	62–13157	0 to 4
		62–13158	4 to 10
		62–13159	13 to 20
Las Lucas loam, 0 to 5 percent slopes: NE¼ sec. 22, T. 19 N., R. 2 W. (Modal)	Windblown material.	62–13165	0 to 4
		62–13166	11 to 23
		62–13167	33 to 60
NE¼NE¼ sec. 7, T. 16 N., R. 2 W. (No Cca horizon)	Windblown material and shale.	62–13181	0 to 4
		62–13182	10 to 26
		62–13183	38 to 50
Litle silty clay, 1 to 5 percent slopes: SE¼NW¼ sec. 15, T. 19 N., R. 3 W. (Modal)	Shale.	62–13168	0 to 5
		62–13169	5 to 20
NE¼NE¼ sec. 18, T. 16 N., R. 3 W. (Shallow)	Shale.	62–13177	0 to 4
		62–13178	9 to 14

See footnotes at end of table.

The engineering soil classifications are based on data obtained by mechanical analysis and by tests to determine the liquid limit and the plasticity index. The tests for liquid limit and plastic limit measure the effect of water on the consistence of the soil material. As the moisture content of a clay soil increases from a very dry state, the material changes from a solid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a solid to a plastic state. The liquid limit is the moisture content at which the material changes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Engineering test data

standard procedures of the American Association of State Highway Officials (AASHO)]

Horizon	Mechanical analysis [1]			Liquid limit	Plasticity index	Classification	
	Percentage passing sieve—					AASHO	Unified [2]
	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
A1	100	87	28	[3] NP	[3] NP	A-2-4(0)	SM.
C1	100	87	25	NP	NP	A-2-4(0)	SM.
Cca	100	92	29	NP	NP	A-2-4(0)	SM.
A1	100	90	57	23	6	A-4(4)	ML-CL.
B2	100	89	52	25	10	A-4(3)	CL.
C	100	80	19	NP	NP	A-2-4(0)	SM.
A1	100	99	67	30	12	A-6(7)	CL.
C1	100	99	95	38	20	A-6(12)	CL.
C3	100	99	86	38	21	A-6(12)	CL.
A1	100	99	94	33	16	A-6(10)	CL.
C1	100	99	86	40	20	A-6(12)	CL.
AC	100	99	96	87	51	A-7-5(20)	MH-CH.
A1	100	91	39	NP	NP	A-4(1)	SM.
B2	100	90	37	NP	NP	A-4(0)	SM.
C2	100	91	27	NP	NP	A-2-4(0)	SM.
A1	100	99	85	34	15	A-6(10)	CL.
B22	100	99	46	24	8	A-4(2)	SC.
Cca	100	99	49	24	7	A-4(3)	SM-SC.
A1	100	97	47	NP	NP	A-4(2)	SM.
B2	100	98	64	29	10	A-4(6)	CL.
C2	100	98	54	24	5	A-4(4)	ML-CL
A1	100	98	71	NP	NP	A-4(7)	ML.
B2	100	97	68	35	16	A-6(9)	CL.
Cca	100	97	85	39	22	A-6(13)	CL.
A1	100	99	65	NP	NP	A-4(6)	ML.
B22	100	99	96	29	10	A-4(8)	CL.
C2	100	99	94	28	12	A-6(9)	CL.
A1	100	99	96	41	20	A-7-6(12)	CL.
C1	100	99	97	50	26	A-7-6(16)	CL.
A1	100	99	81	27	9	A-4(8)	CL.
C	100	99	94	37	20	A-6(12)	CL.

TABLE 3.—*Engineering*

Soil name and location	Parent material	New Mexico report number	
Navajo clay and Gullied land (Navajo part):			*Inches*
SW¼ sec. 16, T. 20 N., R. 1 W. (Modal)	Alluvium.	62–13160	0 to 6
		62–13161	6 to 31
Penistaja fine sandy loam, 0 to 5 percent slopes:			
50 feet SW. of NE. corner of sec. 20, T. 20 N., R. 2 W. (Modal)	Windblown material.	62–13142	0 to 3
		62–13143	9 to 17
		62–13144	22 to 33
NW¼ of sec. 14, T. 17 N., R. 3 W. (No R horizon)	Windblown material.	62–13174	0 to 4
		62–13175	7 to 17
		62–13176	24 to 37
200 yards N. of SE. corner of sec. 14, T. 20 W., R. 4 W. (Modal)	Windblown material.	62–13148	0 to 4
		62–13149	10 to 18
		62–13150	18 to 27
Persayo-Shale outcrop association (Persayo part):			
SW¼ sec. 32, T. 19 N., R. 3 W. (Modal)	Shale.	62–13170	0 to 3
		62–13171	6 to 14
NE¼NE¼ sec. 18, T. 16 N., R. 3 W. (Shallow)	Shale.	62–13179	0 to 5
		62–13180	5 to 20

[1] Mechanical analysis according to AASHO Designation: T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

Engineering properties and interpretations

On the basis of data presented in table 3, properties of the soils of the Cabezon Area were estimated and interpretations for engineering uses were made. Additional information about the soils can be obtained from the sections "Descriptions of the Soils" and "Genesis, Classification, and Morphology of the Soils."

Table 4 gives estimates of the particle-size distribution of the soils. It can be seen that the material of all the soils except Fronton soils and the uppermost 3 inches of Cabezon soils passes through a number 10 sieve. Only 40 to 65 percent of Fronton soils and 40 to 60 percent of the uppermost layer of Cabezon soils pass through a number 4 sieve. Also in table 4 are estimates of the follow-

test data—Continued

Horizon	Mechanical analysis [1]			Liquid limit	Plasticity index	Classification	
	Percentage passing sieve—					AASHO	Unified [2]
	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
A1	100	99	97	52	27	A-7-6(17)	CH.
C1	100	99	98	72	47	A-7-6(20)	CH.
A1	100	99	75	20	3	A-4(8)	ML.
B2	100	99	75	33	14	A-6(10)	CL.
Cca	100	99	56	29	11	A-6(5)	CL.
A1	100	99	60	NP	NP	A-4(5)	ML.
B2	100	99	67	31	14	A-6(8)	CL.
C1ca	100	99	92	26	9	A-4(8)	CL.
A1	100	96	52	NP	NP	A-4(3)	ML.
B2	100	96	51	26	8	A-4(3)	CL.
B3ca	100	94	26	NP	NP	A-2-4(0)	SM.
A1	100	99	89	27	10	A-4(8)	CL.
C2	100	99	95	48	20	A-7-6(14)	ML-CL.
C1	100	96	88	37	18	A-6(11)	CL.
C2	100	99	97	36	18	A-6(11)	CL.

[2] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SM-SC, ML-CL, and MH-CH.
[3] Nonplastic.

ing soil properties that affect engineering work: permeability, available water capacity, reaction, salinity, dispersion, and shrink-swell potential.

The rates of permeability given in table 4 are based on the movement of water through the soil in its undisturbed state. The rates depend largely on the texture and structure of the soils.

Available water capacity is the approximate amount of capillary water in the soil at field capacity. When the soil is at the wilting point of common crops, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation.

Reaction, which indicates the degree of acidity or alkalinity of the soils, is expressed as the pH value. A rating of 7.0 is neutral; lower values indicate increasing acidity, and higher values indicate increasing alkalinity.

TABLE 4.—*Estimated physical*

[No estimates of properties were made for Gullied land, Basalt outcrop, Sandstone outcrop, and Shale outcrop. These land types are not Prewitt, Ravola, and

Series name and map symbols	Depth to bedrock	Depth from surface	Classification		
			USDA texture	Unified	AASHO
	Inches	*Inches*			
Alluvial land (Ak, Au)	>72	0 to 60	Loam	ML	A-4
Badland (Ba) (No estimates given).					
Berent (Bd, Be, Bf)	36 to 60	0 to 9 9 to 18 18 to 60	Loamy fine sand Loamy sand Loamy sand	SM SM SM	A-2 A-2 A-2
Billings (Bg, Bk, Bp) (For Persayo part of Bp, see Persayo series).	>72	0 to 4 4 to 27 27 to 45	Silty clay loam Clay loam Silty clay loam	CL CL CL	A-6 A-6 A-6
Cabezon (Cb, Bc)	8 to 16	0 to 3 3 to 12 12	Stony loam Clay Basalt bedrock	GM CH 	A-4 A-7
Christianburg (Cg)	>72	0 to 60	Clay	CH	A-7
Fronton (Fp) (For Travessilla part of Fp, see Travessilla series; for Persayo part, see Persayo series).	6 to 18	0 to 3 3 to 16 16	Gravelly loam Gravelly clay Soft shale	GM GC 	A-2, A-4 A-7
Fruitland (Fr, Fs) (For Slickspot part of Fs, see Slickspot).	>72	0 to 4 4 to 10 10 to 40	Sandy loam Sandy clay loam Loamy sand	SC SC SC	A-4 A-4, A-2 A-2
Las Lucas (Lc, Ld, Le, Lp) (For Persayo part of Lp, see Persayo series).	[1] 6 to >72	0 to 4 4 to 23 23 to 60	Loam Clay loam Light clay	ML CL CL	A-6 A-6 A-6
Litle (Lr, Ls, Lt, Lu) (For Las Lucas part of Lt, see Las Lucas series; for Persayo part of Lt and Lu, see Persayo series).	14 to 24	0 to 5 5 to 20	Silty clay Silty clay	CL CL	A-7 A-7
Navajo (Ng)	>72	0 to 6 6 to 31	Clay Clay	CH CH	A-7 A-7
Penistaja (Pf, Pg, Pn, Po) (For Berent part of Pn, see Berent series).	>72	0 to 6 6 to 21 21 to 45 45	Fine sandy loam Sandy clay loam Sandy loam Sandy shale	ML, SM CL SM 	A-4 A-4 A-2
Persayo (Pr, Ps)	0 to 16	0 to 6 6 to 14	Silty clay loam Silty clay loam	CL CL-ML	A-4 A-7
Prewitt (Pw)	>72	0 to 9 9 to 23 23 to 60	Loam Sandy clay loam Fine sandy loam	ML CL SC, CL	A-4 A-4 A-4
Ravola (Rg, Rk)	>72	0 to 10 10 to 60	Silty clay loam Loam	CL ML	A-6 A-4
Shavano (Sv) (For Berent part of Sv, see Berent series).	20 to 40	0 to 4 4 to 16 16 to 38 38	Sandy loam Loam Fine sandy loam Sandstone	SM CL SM 	A-2 A-6 A-4
Slickspot	>72	0 to 4 4 to 10 10 to 20	Loamy fine sand Sandy clay loam Sandy loam	SC CL CL-ML	A-4 A-4 A-4

See footnote at end of table.

and chemical properties

mapped separately but as part of several mapping units with Cabezon, Berent, Billings, Christianburg, Navajo, Penistaja, Persayo Travessilla soils]

Percentage passing sieve— No. 10 (2.0 mm.)	Percentage passing sieve— No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
		Inches per hour	*Inches per inch of soil*	*pH value*			
100	70 to 80	0. 05 to 2. 50	0. 17	7. 9 to 9. 0	Slight	High	Moderate.
100	25 to 35	2. 5 to 7. 5	. 10	7. 1 to 7. 3	Slight	Moderate	Moderate.
100	20 to 30	2. 5 to 7. 5	. 10	7. 9 to 8. 4	Slight	Moderate	Moderate.
100	25 to 35	2. 5 to 7. 5	. 10	8. 5 to 9. 0	Slight	Moderate	Moderate.
100	60 to 70	0. 50 to 2. 50	. 17	8. 0 to 8. 4	Slight	Moderate	Moderate.
100	90 to 100	0. 05 to 0. 50	. 17	8. 2 to 8. 6	Slight	Low	High.
100	80 to 90	0. 05 to 0. 50	. 17	8. 4 to 8. 8	Slight	Low	High.
40 to 50	22 to 38	0. 50 to 2. 50	. 09	6. 6 to 7. 3	Nonsaline	Low	Moderate.
100	80 to 90	0. 05 to 0. 20	. 17	6. 6 to 7. 3	Nonsaline	Low	High.
100	90 to 100	0. 00 to 0. 05	. 17	8. 5 to 9. 0	Moderate	Low	High.
40 to 50	30 to 40	0. 50 to 2. 50	. 09	7. 9 to 8. 4	Slight	Low	Moderate.
50 to 60	35 to 45	0. 00 to 0. 05	. 09	7. 9 to 8. 4	Slight	Low	High.
100	40 to 50	2. 50 to 7. 50	. 12	7. 9 to 8. 4	Slight	High	Low.
100	30 to 40	0. 50 to 2. 50	. 17	7. 9 to 8. 4	Slight	High	Moderate.
100	20 to 30	2. 50 to 7. 50	. 10	7. 9 to 8. 4	Slight	High	Low.
100	95 to 100	0. 80 to 2. 50	. 17	7. 9 to 8. 4	Slight	Moderate	Moderate.
100	95 to 100	0. 80 to 2. 50	. 17	7. 9 to 8. 4	Slight	Modedate	High.
100	95 to 100	0. 80 to 2. 50	. 17	7. 9 to 8. 4	Slight	Moderate	High.
100	90 to 100	0. 05 to 0. 50	. 17	7. 9 to 8. 4	Slight	Low	High.
100	90 to 100	0. 05 to 0. 50	. 17	8. 5 to 9. 0	Slight	Low	High.
100	90 to 100	0. 00 to 0. 05	. 18	8. 5 to 9. 0	Slight	Moderate	High.
100	90 to 100	0. 00 to 0. 05	. 18	8. 5 to 9. 0	Severe	Moderate	High.
100	45 to 60	2. 50 to 7. 50	. 13	7. 9 to 8. 4	Slight	Moderate	Low.
100	50 to 60	0. 50 to 7. 50	. 17	7. 9 to 8. 4	Slight	Moderate	Moderate.
100	20 to 30	2. 50 to 7. 50	. 13	7. 9 to 8. 4	Slight	High	Low.
100	85 to 95	0. 50 to 2. 50	. 17	7. 9 to 8. 4	Slight	Low	Moderate.
100	90 to 100	0. 00 to 0. 05	. 17	7. 9 to 8. 4	Slight	Low	High.
100	50 to 60	0. 50 to 1. 50	. 17	7. 9 to 8. 4	Slight	Low	Low.
100	50 to 60	0. 50 to 2. 50	. 17	7. 9 to 8. 4	Slight	Moderate	Moderate.
100	45 to 60	2. 50 to 7. 50	. 13	7. 9 to 8. 4	Slight	Low	Low.
100	60 to 70	0. 05 to 0. 50	. 17	8. 5 to 9. 0	Slight	High	Moderate.
100	70 to 80	0. 50 to 1. 50	. 17	8. 5 to 9. 0	Slight	High	Low.
100	20 to 30	2. 50 to 7. 50	. 12	7. 9 to 8. 4	Slight	Moderate	Low.
100	50 to 60	0. 50 to 2. 50	. 17	7. 9 to 8. 4	Slight	Moderate	Moderate.
100	40 to 50	2. 50 to 7. 50	. 13	7. 9 to 8. 4	Slight	Moderate	Low.
100	40 to 50	0. 00 to 0. 05	. 10	7. 9 to 8. 4	Slight	High	Low.
100	60 to 70	0. 50 to 2. 50	. 17	7. 9 to 8. 4	Slight	Low	Moderate.
100	50 to 60	2. 50 to 7. 50	. 10	9. 1 to 9. 4	Slight	High	Low.

TABLE 4.—*Estimated physical*

Series name and map symbols	Depth to bedrock	Depth from surface	Classification		
			USDA texture	Unified	AASHO
	Inches	*Inches*			
Torreon (To)	>60	0 to 13	Loam	CL	A-6
		13 to 38	Clay	CH	A-7
		38 to 60	Clay loam	CL	A-6
Travessilla (Rt, St, Tp) (For Persayo part of Rt and Tp, see Persayo series; for Billings part of Tp, see Billings series).	6 to 16	0 to 8	Fine sandy loam	SM	A-4
		8	Sandstone		A-4

[1] Lc and Ld, 40 to 60 inches; Le, more than 72 inches; Lp, 6 to 72 inches.

Dispersion refers to the degree and speed with which soil structure breaks down, or slakes, in water. High means that the soil aggregates slake readily.

Shrink-swell potential indicates the volume change to be expected when the soil material changes in moisture content. In general, soils classed as CH and A–7 have high shrink-swell potential. Clean sand and most other nonplastic soil materials have low shrink-swell potential.

TABLE 5.—*Interpretations of*

[No interpretations were made for Gullied land, Basalt outcrop, Sandstone outcrop, and Shale outcrop. These land types are not mapped Prewitt, Ravola,

Soil series and map symbols	Suitability as a source of—			Soil features affecting use of the soils for—	
	Topsoil	Road subgrade	Road fill	Highways	Foundations for small buildings
Alkali alluvial land (Ak)	Unsuitable	Fair	Unsuitable to fair.	Erodibility	Moderate shrink-swell potential.
Alluvial land (Au)	Good	Good	Good	Erodibility	Moderate shrink-swell potential.
Badland (Ba)	Unsuitable	Poor	Unsuitable	Shallowness to shale.	Very high shrink-swell potential.
Berent (Bd, Be, Bf)	Poor	Fair to good.	Fair	High erodibility; good internal drainage.	Moderate shrink-swell potential.
Billings (Bg, Bk, Bp) (For Persayo part of Bp, see Persayo series).	Fair to depth of 6 inches.	Poor to fair	Poor	High plasticity; susceptibility to frost action.	High shrink-swell potential.
Cabezon (Cb, Bc)	Unsuitable	Poor to fair	Unsuitable	High plasticity; susceptibility to frost action.	High shrink-swell potential.
Christianburg (Cg)	Poor	Poor to fair	Unsuitable	High susceptibility to frost action; impervious material.	High shrink-swell potential.

and chemical properties—Continued

Percentage passing sieve— No. 10 (2.0 mm.)	Percentage passing sieve— No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
		Inches per hour	*Inches per inch of soil*	*pH value*			
100	65 to 75	0. 50 to 2. 50	. 17	6. 6 to 7. 3	Nonsaline	Low	Moderate.
100	80 to 90	0. 05 to 0. 20	. 17	6. 6 to 7. 3	Nonsaline	Low	High.
100	65 to 75	0. 50 to 2. 50	. 17	6. 6 to 7. 3	Nonsaline	Low	Moderate.
100	40 to 50	2. 50 to 7. 50	. 18	7. 9 to 8. 4	Slight	Moderate	Low.
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Table 5 gives the suitability of the soils for certain uses and describes specific characteristics that affect the design and construction of highways and structures. These interpretations are based on actual test data, as shown in table 3, on the estimates shown in table 4, and on field experience. The column headings in table 5 are, for the most part, self explanatory.

engineering properties

separately but as part of several mapping units with Cabezon, Berent, Billings, Christianburg, Fruitland, Navajo, Penistaja, Persayo and Travessilla soils]

Soil features affecting use of the soils for—Continued: Dikes and levees	Small earthen dams: Reservoir	Small earthen dams: Embankment	Range improvements through chiseling and ripping	Terraces and diversions	Hydrologic soil group
Good stability when compacted.	Permeable unless compacted.	Good compaction at proper moisture content.	Moderate to rapid intake rate.	Good stability when compacted.	C.
Good stability when compacted.	Good stability when compacted.	Good compaction at proper moisture content.	Moderate to rapid intake rate.	Good stability when compacted.	C.
Shallowness to shale	Shallowness to shale	Shallowness to shale	Shallowness to shale	Shallowness to shale	D.
High erodibility	Excess seepage	High erodibility	Rapid intake rate	High erodibility	A.
Good stability when compacted; compact when moist.	Slow permeability; should be kept wet; cracks when dry.	Good stability when compacted at proper moisture content.	Slow intake rate; short-lived benefits.	Erodibility in some areas.	D.
Good stability when compacted; limited amount of soil available.	Stoniness, shallowness, and steepness.	Limited amount of soil available; stoniness and steepness.	Shallowness and stoniness.	Shallowness and stoniness.	B.
Resistance to erosion and piping; fair stability when compacted.	Highly impervious	Impervious; fair stability when compacted.	Slow intake rate; high water-holding capacity.	Resistance to erosion and piping; fair stability when compacted.	D.

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting use of the soils for—	
	Topsoil	Road subgrade	Road fill	Highways	Foundations for small buildings
Fronton (Fp) (For Travessilla part of Fp, see Travessilla series; for Persayo part of Fp, see Persayo series).	Poor	Poor	Fair to good.	High plasticity	High shrink-swell potential.
Fruitland (Fr, Fs) (For Slickspot part of Fs, see Slickspot).	Good to depth of 10 inches.	Good	Good	Good stability; small volume changes.	All features favorable.
Las Lucas (Lc, Ld, Le, Lp) (For Persayo part of Lp, see Persayo series).	Good to depth of 6 inches.	Poor to fair	Poor	Moderate to high plasticity.	High shrink-swell potential.
Litle (Lt, Ls, Lr, Lu) (For Las Lucas part of Lt, see Las Lucas series; for Persayo part of Lt and Lu, see Persayo series).	Fair to depth of 2 to 6 inches.	Poor to fair	Unsuitable	Moderate plasticity	High shrink-swell potential.
Navajo (Ng)	Poor	Poor to fair.	Unsuitable	High susceptibility to frost action; impervious material.	High shrink-swell potential.
Penistaja (Pf, Pg, Pn, Po) (For Berent part of Pn, see Berent series).	Good to depth of 4 inches.	Poor to fair.	Fair	Susceptibility to frost action.	All features favorable.
Persayo (Pr, Ps)	Fair to depth of 2 to 4 inches.	Poor to fair.	Unsuitable	Shallowness to shale.	Shallowness to shale.
Prewitt (Pw)	Fair; easily eroded on slopes.	Fair	Poor to fair.	High erodibility; unstable slopes.	All features favorable.
Ravola (Rg, Rk)	Fair to depth of 3 to 12 inches.	Poor to fair.	Unsuitable	Erodibility	All features favorable.
Shavano (Sv) (For Berent part of Sv, see Berent series).	Fair to depth of 4 inches.	Good	Good	Sandstone below depth of 3 feet.	All features favorable.
Slickspot	Unsuitable	Fair	Fair	Moderate to high susceptibility to to frost action.	Moderate to high shrink-swell potential.
Torreon (To)	Good to depth of 4 inches.	Poor to fair.	Unsuitable	High plasticity	High shrink-swell potential.
Travessilla (Rt, St, Tp) (For Persayo part of Rt and Tp, see Persayo series; for Billings part of Tp, see Billings series).	Unsuitable	Good	Fair to good.	Shallowness to sandstone.	All features favorable.

engineering properties—Continued

Soil features affecting use of the soils for—Continued					Hydrologic soil group
Dikes and levees	Small earthen dams		Range improvements through chiseling and ripping	Terraces and diversions	
	Reservoir	Embankment			
Shale at depth of 6 to 18 inches.	Shallowness	Limited amount of soil available.	Shallowness and stoniness.	Shale at depth of 6 to 18 inches.	C.
Fair stability when compacted; compact when moist.	Rapid permeability	Fair stability when compacted; compact when moist.	Good intake rate; no inhibiting layer.	Fair stability without compaction.	B.
Good stability when compacted.	Moderately slow permeability; should be kept wet; cracks when dry.	Good stability when compacted at optimum moisture content.	Slow intake rate; high water-holding capacity.	Good stability when compacted.	C.
Shale at depth of 16 to 20 inches.	Shallowness	Limited amount of soil available.	Susceptibility to piping.	Shallowness	D.
Resistance to piping and erosion; fair stability when compacted.	Highly impervious	Impervious when compacted; fair stability.	Slow intake rate; high water-holding capacity.	Resistance to erosion and piping; fair stability when compacted.	D.
Good stability when compacted.	Susceptibility to seepage; can be controlled by compaction or salting.	Good stability when compacted at optimum moisture content.	Slow permeability in subsoil; long-lived benefits.	Good stability	B.
Shallowness to shale	Shallowness to shale; very high in gypsum.	Shallowness to shale	Shallowness to shale	Shallowness to shale	D.
Erodibility; fair stability when compacted.	Moderate to rapid permeability.	Good compaction at optimum moisture content.	Rapid intake rate; erodibility; short-lived benefits.	Erodibility; fair stability when compacted.	B.
Good stability when compacted.	Moderate permeability; may need compaction to prevent seepage.	Good stability when compacted; compact when moist.	Susceptibility to flooding; moderate intake rate; moderate water-holding capacity.	Excess water may cause erosion.	B.
Good stability when compacted.	Sandstone at depth of 3 feet.	Good stability; good compaction.	Moderate to high intake rate.	Good stability	B.
High erodibility; poor resistance to piping.	Slow permeability	High erodibility; poor resistance to piping.	Slow intake rate; short-lived benefits.	High erodibility	D.
Resistance to erosion and piping; fair stability when compacted.	Impervious soil material.	Good compaction at optimum moisture content.	Slow intake rate; high water-holding capacity.	Good stability	C.
Shallowness to sandstone; erodibility.	Shallowness to sandstone.	Erodibility; shallowness to sandstone.	Shallowness to sandstone.	Shallowness to sandstone.	B to D.

At many construction sites, major variations in soil characteristics may occur within the depth of proposed excavations and several kinds of soils may be encountered within a short distance. It cannot be assumed that the information given in table 5 applies to all layers of the soils. Furthermore, variations in profiles, for example, variations in the depth to shale, may affect use of the soils for some kinds of structures or practices. The information can be used as a guide to enable the engineer to determine which soils are most suitable for specific uses. Then, a minimum number of soil samples will be needed for testing in the laboratory.

Many of the soils are rated poor or unsuitable as a source of topsoil because they are too sandy to be fertile or are too saline or alkali for plants. Salts and alkali also seriously increase the piping hazard, disturb the internal drainage, and decrease the workability of the soils.

Only Fronton soils of Fronton-Travessilla-Persayo association and Persayo soils of Persayo gravelly soils-Shale outcrop association are suitable sources of gravel. Even these soils are not consistently dependable sources.

Susceptibility to frost action is of special concern in locating highways. Soils that have a high percentage of silt and clay generally are more susceptible to frost action than soils that have a low percentage. Other properties that affect susceptibility to frost action include permeability of the underlying soil layers, the depth to the water table, the moisture content of the soil, and the temperature and drainage.

The features shown in the column "Dikes and levees" were determined for material to a depth of 30 inches and apply only to low structures.

The features that affect the construction of small earthen dams can serve as a guide for planning larger dams, but detailed on-site investigations would be needed.

The features mentioned in the column "Terraces and diversions," besides erodibility and susceptibility to piping, are those that affect the use of the soils as borrow material.

Ratings in the column "Hydrologic soil group" apply to the entire soil profile. Soils are placed in four groups on the basis of intake of water at the end of a long-duration storm, after prior wetting and swelling and without the protection of vegetation. Group A consists of deep sands that contain little silt and clay and deep, rapidly permeable loessal soils. These soils soak up the most rain and have the least runoff. Group B consists mostly of sandy soils that are less deep than the soils in group A and loessal soils that are less deep or less aggregated. Soils in this group absorb more water than average, even after they are thoroughly wet. Group C consists of shallow soils and soils that contain large amounts of clay and colloidal particles but smaller amounts than the soils in group D. Group C soils absorb less water than average after being thoroughly wet. Group D consists mostly of clays that increase greatly in volume when they absorb water but partly of shallow soils that have nearly impermeable layers near the surface. Soils in group D soak up the least rain and lose the most as runoff.

Genesis, Classification, and Morphology of the Soils

This section discusses the factors of soil formation, the classification of the soils by higher categories, and the morphology of the soils. In the last part, each soil series is discussed briefly and a representative profile of each is described in detail.

Factors of Soil Formation

Soil is formed by weathering and other processes that act on materials deposited or accumulated by geologic agencies. The characteristics of a soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life are the active factors of soil formation. They act on the parent material accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines most of the characteristics. Finally, time is needed for the changing of the parent material into a soil profile. The amount of time may be much or little, but generally a long time is required for distinct horizons to develop.

The factors of soil genesis are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified for the other four.

Parent material

The soils of the Cabezon Area formed from parent material deposited during the Permian, Cretaceous, Tertiary, and Quaternary periods. No formations of the Permian period underlie the survey Area, but material derived from the Abo sandstone formation of that period was exposed to the east of the Area by the Nacimiento Uplift and was washed into the Area by the Rio Puerco. Abo sandstone has imparted a distinct red color to the Prewitt and Navajo soils. This formation has contributed the oldest parent material to the Area. It is composed of brick-red, maroon, gray, and greenish-gray shale, siltstone, sandstone, and conglomerate.

Point Lookout sandstone and Mancos shale of the Cretaceous system occur in the southern part of the Area. Persayo, Litle, and Las Lucas soils formed in material weathered from Mancos shale. They are susceptible to piping and consequently present problems in engineering.

The Menefee formation (sandstone and shale) and Cliff House sandstone of the Cretaceous system are

exposed in much of the Area. The shallow Persayo and Travessilla soils formed in material weathered from these formations. The areas mapped as Rock outcrop and Badland also overlie these formations. Steep cliffs, outcrops, and numerous intermittent drainageways have formed as a result of differential erosion.

Lewis shale, Pictured Cliffs sandstone, and Kirtland shale of the Cretaceous system are in the northern part of the Area. They contributed the parent material of Litle and Las Lucas soils and minor areas of the land types and shallow soils.

The Nacimiento group of the Tertiary system underlies the northern part of the Area. It is partly covered by eolian deposits, which evidently blew from the southwest, since sand occurs on the lee side of cliffs and hills. Penistaja and Berent soils developed in part from these eolian deposits.

During the Tertiary period, basalt flows covered Chivato Mesa in the southwestern corner of the Area. Cabezon and Torreon soils formed from this material and from latite, andesite, tuff, and other volcanic debris.

In the Quaternary, or Recent period, alluvium deposited on the flood plains along streams gave rise to Christianburg, Billings, and Ravola soils.

Climate

The Cabezon Area has a semiarid climate. The average annual precipitation is low (see table 7, p. 42). Thunderstorms during summer produce most of the rainfall, about 40 percent of which falls during July and August. Seldom does more than 1 inch of rain fall during a single rainstorm, and consequently the natural vegetation consists mainly of shallow-rooted, short grasses. Because of strong winds and low humidity, the rate of evaporation is high, and water seldom penetrates to a depth of more than 2 feet. In most of the soils, therefore, the basic elements accumulate as a weak lime zone within 2 or 3 feet of the surface.

The small amount of water that moves downward through the soils carries particles of clay with it. This finer textured material can be seen in the subsoil of Penistaja soils.

Strong winds have influenced the formation of some of the soils. Berent soils, for example, formed in eolian, or wind-deposited, material. In addition, the winds have blown away the finer particles from the surface layer of some soils.

Plant and animal life

Trees, other plants, micro-organisms, earthworms, and other forms of life are active forces in soil formation. They help to decompose plant residues and to hasten soil development. Worm casts and roots increase water intake and percolation.

Vegetation provides shade and reduces the loss of moisture through runoff and evaporation. It adds organic matter and helps to improve the structure and physical condition of the soil. Plant roots help to bring minerals from the parent material to the surface soil in a form that plants can use.

Relief

Relief, or lay of the land, helps to determine the kinds of soils that develop in an area. It affects drainage, amount and kind of organic matter accumulated in the surface layer, depth, degree of horizon development, and salinity.

Other soil-forming factors being equal, the degree of horizon development depends on the average amount of moisture in the soil. For example, a nearly level soil that has little runoff generally is better developed than a sloping soil. On stronger slopes, the soil-forming processes are retarded by the continuing loss of soil material through erosion and runoff.

Time

The length of time required for a soil to form depends on the combined action of the other four soil-forming factors and on the intensity of their action. Soils develop slowly if the climate is dry and the vegetation is sparse, as is the case in the Cabezon Area.

Some nearly level, deep soils, for example, Penistaja soils, have distinct horizons and are said to be mature. Christianburg, Navajo, and other deep soils have indistinct horizons or have a profile consisting only of A and C horizons and are said to be young, or immature. Steeply sloping, shallow soils also are immature, even if they have been in place for a long time, because relief and consequent geologic erosion have overcome the influence of the other factors of soil formation.

Classification and Morphology of the Soils

Soils are classified in various categories to make it easier to organize and apply knowledge about their behavior to farms or ranches, areas, counties, or continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later. The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965.[5] It is under continual study. Therefore, readers interested in developments of the system should refer to the latest literature available (*6*). Table 6 shows the classification of each soil series of the Cabezon Area by family, subgroup, and order of the current system, and by great soil group of the 1938 system.

In the course of the soil survey program, new soil series must be established and concepts of some established series, especially older ones that have been used little in recent years, must be revised. A proposed new series has tentative status until review of the series concept at State, regional, and national levels of responsibility for soil classification results in a judgment that the new series should be established. All of the soil series described in this publication except the Penistaja and Torreon series had been established earlier. The Penistaja and Torreon series had tentative status when the survey was sent to the printer.

In the 1938 system, soils are placed in six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great soil group, the family, the series, and the type. The categories of the suborder and family have never been fully developed and therefore have been little used. In soil classification according to the 1938 system, attention has been given

[5] UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL SURVEY STAFF, SCS. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM, 7TH APPROXIMATION. 1960. [Amended January 1967]

TABLE 6.—*Soil series classified according to the current system of classification and the 1938 system*

Series	Current system			1938 system
	Family	Subgroup	Order	Great soil group
Berent	Sandy, mixed, nonacid, mesic	Typic Torripsament	Entisol	Regosol.
Billings	Fine silty, mixed, calcareous, mesic	Typic Torrifluvent	Entisol	Alluvial.
Cabezon	Clayey, montmorillonitic, mesic	Lithic Argiustoll	Mollisol	Chestnut.
Christianburg	Fine, mixed, calcareous, mesic	Typic Torrifluvent	Entisol	Alluvial.
Fronton	Fine, mixed, mesic	Mollic Haplargid	Aridisol	Brown.
Fruitland	Coarse loamy, mixed, calcareous, mesic	Typic Torrifluvent	Entisol	Alluvial
Las Lucas	Fine silty, mixed, mesic	Mollic Camborthid	Aridisol	Brown.
Litle	Fine, mixed, mesic	Mollic Camborthid	Aridisol	Brown.
Navajo	Fine, mixed, calcareous, mesic	Typic Torriorthent	Entisol	Alluvial.
Penistaja	Fine loamy, mixed, mesic	Mollic Haplargid	Aridisol	Brown.
Persayo	Loamy, mixed, calcareous, mesic, shallow	Typic Torriorthent	Entisol	Lithosol.
Prewitt	Fine loamy, mixed, mesic	Entic Haplustoll	Mollisol	Alluvial.
Ravola	Fine silty, mixed, calcareous, mesic	Typic Torrifluvent	Entisol	Alluvial.
Shavano	Fine loamy, mixed, mesic	Mollic Camborthid	Aridisol	Regosol.
Torreon	Fine, montmorillonitic, mesic	Typic Argiustoll	Mollisol	Chestnut.
Travessilla	Loamy, mixed, calcareous, mesic	Lithic Torriorthent	Entisol	Lithosol.

largely to the classification of soil types and series within counties or comparable areas and to the subsequent grouping of the series into great soil groups and orders.

The lower categories of classification—the soil series, type, and phase—are defined in the Glossary at the back of this soil survey. The soil series are classified into great soil groups, and the groups into soil orders (7).

There are three soil orders—the zonal, the intrazonal, and the azonal. Only the zonal and azonal orders are represented in this Area.

The zonal order is made up of soils that have a well-developed profile. These soils reflect the predominant influence of climate and living organisms in their formation. The zonal order is represented in this survey Area by the Chestnut and Brown great soil groups.

The azonal order is made up of soils that lack a well-developed profile, commonly because of youth, resistant parent material, or steepness. In this Area the azonal order is represented by Alluvial soils, Lithosols, and Regosols.

The great soil groups represented in this Area are discussed in the following paragraphs.

Chestnut soils

Chestnut soils are zonal soils. They have a grayish-brown surface layer underlain by darker colored material. At a depth of 1 to 4 feet is a horizon of lime accumulation. These soils form under short grasses, pinyon pine, and ponderosa pine in a temperate to cool, subhumid to semiarid climate.

The Chestnut group is represented in the Cabezon Area by the Cabezon and Torreon series.

Brown soils

Brown soils are zonal soils. They have a light brownish-gray to pale-brown surface layer, commonly of strong granular structure. The subsoil is finer textured than the surface soil. In most profiles there is an accumulation of calcium carbonate at a depth of 1½ to 2 feet. Brown soils form under short grasses and sagebrush in a temperate to cool climate.

The Brown group is represented in the Cabezon Area by the Fronton, Litle, Las Lucas, and Penistaja series.

Alluvial soils

Alluvial soils are azonal soils. They form in transported and recently deposited material. The surface layer has been darkened by organic matter and has developed a granular structure. Otherwise, the soils have had little or no modification by soil-forming processes.

The Alluvial group is represented in the Cabezon Area by the Billings, Christianburg, Fruitland, Navajo, Prewitt, and Ravola series.

Lithosols

Lithosols are azonal soils. They have little or no evidence of soil development and consist mainly of a partly weathered mass of rock fragments or of coarse sand and gravel.

The Lithosol group is represented in the Cabezon Area by the Persayo and Travessilla series.

Regosols

Regosols are light-colored azonal soils. They consist of thick, unconsolidated deposits and do not have definite genetic horizons. In the Cabezon Area, the unconsolidated deposits are sand.

The Regosol group is represented in this Area by the Berent and Shavano series.

Representative Soil Profiles

This section was prepared for those who need more scientific information about the soils in the Area than is given elsewhere in the soil survey. In the following pages each soil series in the Cabezon Area is discussed briefly and a profile of a soil representative of the series is described. Topography, surface drainage, permeability, vegetation, and dominant land use are described in the section "Descriptions of the Soils."

Berent Series

The Berent series consists of soils that are light colored, coarse textured and porous, excessively drained, and noncalcareous. These soils formed in eolian material. The slope range is 0 to 9 percent. The elevation ranges from 6,600 to 6,900 feet. The rainfall totals 12 to 14 inches.

Berent soils are less mature and coarser textured than Penistaja soils. They are less mature and are leached to a greater depth than Las Lucas soils.

Typical profile, located in the NE. corner of sec. 27, T. 20 N., R. 4 W.:

A1—0 to 9 inches, light-brown (7.5YR 6/4) loamy fine sand, dark brown (7.5YR 3/4) when moist; weak, fine to medium, granular structure; loose when dry, very friable when moist; topmost one-eighth inch is a dispersed crust; clear, smooth boundary.

C1—9 to 19 inches, brown (7.5YR 5/3) loamy sand, dark brown (7.5YR 4/3) when moist; weak, medium to coarse, subangular blocky structure; slightly hard when dry, friable when moist; numerous roots and worm casts; clear, smooth boundary.

C2—19 to 26 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 5/3) when moist; massive; hard when dry, firm when moist; numerous roots and worm casts; clear, smooth boundary.

C3—26 to 46 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; massive; hard when dry, firm when moist; clear, smooth boundary.

C4—46 to 51 inches, reddish-yellow (7.5YR 7/6) loamy fine sand, strong brown (7.5YR 5/6) when moist; massive; hard when dry, friable when moist; few iron stains; few calcium carbonate concretions and lime threads; slightly calcareous; clear, smooth boundary.

C5—51 to 60 inches, reddish-yellow (7.5YR 6/6) loam, dark brown (7.5YR 4/4) when moist; some mottling of strong brown (7.5YR 5/8); massive; very hard when dry, friable when moist; partly indurated sandstone with some dark-colored shale particles; few calcium carbonate concretions; slightly calcareous.

The A horizon ranges from 6 to 12 inches in thickness and from loamy fine sand to fine sandy loam in texture. It has weak, thick, platy structure in some places. Although coarse textured, the C1 and C2 horizons tend to be sticky. The depth to sandstone typically is more than 60 inches, but it may be as little as 36 inches.

Billings Series

The Billings series consists of soils that are immature, slightly calcareous, and well drained. These soils formed in material weathered from alkaline shale and are mainly on smooth slopes of alluvial fans and flood plains. The slope range is 0 to 5 percent.

Billings soils are coarser textured than Christianburg soils. They are coarser textured in the subsoil than Navajo soils and lack the reddish-brown color typical of those soils. Billings soils are less red than Prewitt soils.

Typical profile, located in the SE¼NE¼ sec. 3, T. 20 N., R. 1 W.:

A1—0 to 4 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak to medium platy structure; soft when dry, very friable when moist; topmost one-eighth inch is a dispersed gray crust; slightly calcareous; abrupt, clear boundary.

AC—4 to 7 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak to moderate, medium, granular structure; slightly hard when dry, friable when moist; calcium carbonate concretions throughout; strongly calcareous; clear, smooth boundary.

C1—7 to 27 inches, grayish-brown (10YR 5/2) silty clay loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic to columnar structure breaking to medium subangular blocky; very hard when dry, very friable when moist; many roots and worm casts; calcium carbonate concretions throughout; strongly calcareous; clear, smooth boundary.

C2—27 to 45 inches, light brownish-gray (10YR 6/2) silty clay loam, dark yellowish brown (10YR 3/4) when moist; weak to moderate, medium to coarse, subangular blocky structure; very hard when dry, firm when moist; many roots and worm casts; calcium carbonate concretions throughout; strongly calcareous; clear, smooth boundary.

C3—45 to 60 inches, pale-brown (10YR 6/3) very fine sandy clay loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist; many roots and worm casts; calcium carbonate concretions throughout; strongly calcareous; clear, smooth boundary.

The A horizon ranges from 2 to 6 inches in thickness and from very fine sandy loam or loam to silty clay loam in texture. The C horizon ranges from clay loam to silty clay loam and has thin strata of coarser textured material. The hue ranges from 2.5Y to 10YR.

Cabezon Series

The Cabezon series consists of well-drained soils that formed in material weathered from basalt and volcanic debris. These soils occur only on mesa tops and benches. The slope typically is 10 percent, but it ranges up to 15 percent.

Cabezon soils formed in the same kind of material as Torreon soils, but Cabezon soils are shallower.

Typical profile, located near the eastern edge of Chivato Mesa:

A1—0 to 3 inches, grayish-brown (10YR 5/2) stony loam, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; 65 to 90 percent of surface covered with stones and cobbles; clear, smooth boundary.

B2t—3 to 12 inches, brown (7.5YR 5/2) clay, dark brown (7.5YR 3/2) when moist; moderate to strong, medium, subangular blocky structure; hard when dry, friable when moist; thin, continuous clay films; gravel content less than 20 percent, by volume; abrupt, smooth boundary.

R—12 inches, basalt bedrock; normally lime coated in the uppermost one-fourth inch.

The A horizon ranges from 2 to 6 inches in thickness and from loam to light clay loam in texture. The B horizon ranges from clay loam to clay. The basalt bedrock contains a coating of lime in some places and occurs at a depth of 8 to 16 inches.

Christianburg Series

The Christianburg series consists of soils that are deep, well drained, calcareous, and immature. These soils formed in material weathered from alkaline shale and sandstone. They occur mainly on flood plains and terraces. The slope typically is less than 1 percent, but the range is 0 to 3 percent.

Christianburg soils are finer textured than Billings soils. They are less red than Navajo soils, with which they are closely associated. Christianburg soils are finer textured and less red than Prewitt soils.

Typical profile, in an uncultivated area at the NW. corner of the SW¼ sec. 30, T. 20 N., R. 1 W.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure to moderately strong, very fine, granular; very hard when dry, firm when moist; one-fourth inch crust of light brownish gray (2.5Y 6/2) at the surface; calcareous; pH 8.6; clear, smooth boundary.

AC—3 to 6 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure; very hard when dry, extremely firm when moist; calcareous; pH 8.7; clear, smooth boundary.

C—6 to 60 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak to moderate, fine and medium, angular blocky structure; very hard when dry, extremely firm when moist; abundant salt crystals; calcareous; pH 8.6.

The A horizon ranges from 2 to 8 inches in thickness. The hue typically is 2.5Y, but it tends toward 10YR. The AC and C horizons normally are a heavy, dense clay that contains strata of coarser textured material.

Fronton Series

The Fronton series consists of well-drained soils that formed in igneous alluvium deposited over shale and, in spots, over sandstone. These soils are on foothills.

Fronton soils are redder colored and shallower to shale than Las Lucas soils and Litle soils. Fronton soils are better developed than Persayo soils.

Typical profile, located in the NE¼ sec. 4, T. 19 N., R. 1 W.:

A1—0 to 3 inches, light-brown (7.5YR 6/4) gravelly loam, dark brown (7.5YR 3/4) when moist; weak, fine, granular structure; soft when dry, very friable when moist; about 75 percent of surface covered with igneous rock and pebbles; neutral, but may be weakly calcareous in places; clear, smooth boundary.

B1—3 to 7 inches, reddish-brown (5YR 5/4) gravelly clay, reddish brown (5YR 4/4) when moist; moderate or strong, very fine, subangular blocky structure; hard when dry, friable when moist; thin, patchy clay films on inner and outer faces of aggregates; about 35 percent gravel; clear, smooth boundary.

B2t—7 to 11 inches, light reddish-brown (5YR 6/3) gravelly clay, reddish brown (5YR 5/3) when moist; strong, medium and coarse, subangular blocky structure; very hard when dry, very firm when moist; thin, continuous clay films on surface of soil aggregates; about 35 percent gravel; clear, smooth boundary.

B3ca—11 to 16 inches, pinkish-gray (5YR 6/2) heavy clay loam, dark reddish brown (5YR 2/2) when moist; moderate, medium and coarse, subangular blocky structure; very hard when dry, firm when moist; common, patchy clay films and some salt crystals; very strongly calcareous; clear, smooth boundary.

R—16 inches +, partly weathered, soft, gray shale; very strongly calcareous.

The A horizon ranges from 2 to 6 inches in thickness and from gravelly very fine sandy loam or gravelly loam to gravelly light clay loam in texture. The subsoil ranges from 8 to 14 inches in thickness and from gravelly clay loam to gravelly clay in texture. The gravel in the subsoil ranges from 25 to 50 percent, by volume. The depth to shale ranges from 6 to 8 inches on the steeper slopes and from 14 to 18 inches on the lesser slopes.

Fruitland Series

The Fruitland series consists of well-drained soils that formed in alluvium underlain by sandstone and sandy shale. These soils are on bottom lands and mesa slopes.

Fruitland soils are coarser textured and more leached than Billings soils. They are more mature and much coarser textured than Christianburg soils but are less saline and alkali in the upper horizons.

Typical profile, located an eighth of a mile south of the center of sec. 11, T. 20 N., R. 2 W.:

A11—0 to 3 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; strong, very fine, granular structure; soft when dry, very friable when moist; mildly alkaline; clear boundary.

A12—3 to 6 inches, light brownish-gray (10YR 6/2) heavy sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; very hard when dry, very friable when moist; noncalcareous; mildly alkaline; clear boundary.

AC—6 to 12 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; very hard when dry, very friable when moist; mildly alkaline; clear boundary.

C1—12 to 16 inches, light olive-brown (2.5Y 5/3) heavy loamy sand, olive brown (2.5Y 4/3) when moist; massive; very hard when dry, very friable when moist; mildly alkaline; gradual boundary.

C2—16 to 33 inches, light olive-brown (2.5Y 5/3) sandy loam, olive brown (2.5Y 4/3) when moist; massive; very hard when dry, very friable when moist; mildly alkaline; gradual boundary.

C3—33 to 60 inches +, light brownish-gray (2.5Y 6/2) sandy loam stratified with thin lenses of sandy clay loam, grayish brown (2.5Y 5/2) when moist; massive; noncalcareous; mildly alkaline, except for a few thin, discontinuous seams of strongly alkaline material.

The A horizon ranges from 3 to 6 inches in thickness and from loamy sand to sandy loam or loam in texture. The texture of the C horizon ranges from loamy sand to sandy loam or sandy clay loam.

Las Lucas Series

The Las Lucas series consists of well-drained soils that formed in alluvial deposits over shale. These soils are on uplands. The slope range is 0 to 9 percent.

Las Lucas soils are deeper to shale than Litle soils. They are much deeper and more mature than Persayo soils.

Typical profile, located about 20 feet NE. of the SE. corner of sec. 16, T. 19 N., R. 2 W.:

A1—0 to 8 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; weak, medium, platy structure in the uppermost 1 or 2 inches and moderate, fine, granular in the lower part; slightly hard when dry, friable when moist; slightly calcareous; abrupt, smooth boundary.

B2—8 to 15 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) when moist; moderate, medium and coarse, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; clear, irregular boundary.

B3ca—15 to 22 inches, yellowish-brown (10YR 5/4) clay loam, dark yellowish brown (10YR 3/4) when moist; weak, medium, angular and subangular blocky structure; very hard when dry, friable when moist; very strongly calcareous; gradual, smooth boundary.

C1ca—22 to 40 inches, light yellowish-brown (2.5Y 6/4) light clay loam, light olive brown (2.5Y 5/4) when moist; massive; hard when dry, friable when moist; strongly calcareous; gradual boundary.

C2—40 inches +, thick, laminated shale with many salt crystals between the plates.

The A horizon ranges from 4 to 10 inches in thickness and from loam to sandy clay loam or clay loam in texture. The B horizon ranges from 5 to 15 inches in thickness and from heavy loam to clay loam in texture. The amount of salt crystals, mainly calcium sulfate, ranges to moderate below a depth of 40 inches. The more strongly developed

profiles have some thin clay flows on ped faces. The depth to shale ranges from 40 to more than 60 inches.

Litle Series

The Litle series consists of well-drained soils that formed in material weathered from Cretaceous shale. These soils are on uplands, at an elevation of 6,200 to 6,500 feet. The slope range is 0 to 9 percent. The rainfall totals 10 to 12 inches.

Litle soils are shallower and less mature than Las Lucas soils. They are deeper than Persayo soils, with which they are closely associated and which occur on the ridge crests and the tops of shale knolls.

Typical profile, located in the SE¼NE¼ sec. 28, T. 19. N., R. 3 W.:

A1—0 to 2 inches, light olive-brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) when moist; weak, fine, granular structure; hard when dry, very friable when moist; topmost one-fourth inch is a dispersed gray crust; highly vesicular; strongly calcareous; clear, smooth boundary.

B21—2 to 4 inches, light yellowish-brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) when moist; weak, fine, granular structure; hard when dry, very friable when moist; strongly calcareous; clear, smooth boundary.

B22—4 to 12 inches, light yellowish-brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) when moist; weak, medium, subangular blocky structure; very hard when dry, friable when moist; strongly calcareous; clear, smooth boundary.

B3ca—12 to 24 inches, light olive-brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) when moist; weak, medium, angular blocky structure; very hard when dry, firm when moist; few visible salt concretions and few shale fragments; strongly calcareous; clear, smooth boundary.

Cca—24 to 30 inches, decomposed shale fragments; some sandstone fragments and salt crystals.

R—30 inches +, shale with abundant salt crystals and some sandstone fragments.

The surface texture is sandy clay loam, silty clay loam, or light silty clay. The hue of the entire profile ranges from 10YR to 2.5Y. Salt crystals and shale fragments occur throughout the profile in some places. The depth to shale typically is 18 inches, but it ranges from 14 to 24 inches.

Navajo Series

The Navajo series consists of soils that are reddish brown, deep, poorly drained, calcareous, and immature. These soils occur in small areas on flood plains and terraces. They are mildly saline in some areas and contain an abundance of salt crystals in others. The slope range is 0 to 3 percent.

Navajo soils are redder than Christianburg soils and Billings soils. Navajo soils resemble Prewitt soils in color but are finer textured and more alkaline.

Typical profile, in an uncultivated area located in the SW¼ sec. 20, T. 20 N., R. 1 W.:

A1—0 to 2 inches, reddish-brown (5YR 5/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; soft when dry, friable when moist; topmost one-fourth inch is a dispersed crust; strongly calcareous; clear, abrupt boundary.

AC—2 to 4 inches, reddish-brown (5YR 5/3) clay, reddish brown (5YR 4/3) when moist; weak, fine, angular blocky structure; very hard when dry, extremely firm when moist; strongly calcareous; clear, smooth boundary.

C1—4 to 37 inches, reddish-brown (5YR 5/4) clay, dark reddish brown (5YR 3/4) when moist; weak, fine, angular blocky structure; very hard when dry, extremely firm when moist; abundant salt crystals; very strongly calcareous; clear, smooth boundary.

IIC2—37 to 51 inches, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 4/4) when moist; weak, thin, platy structure; slightly hard when dry, friable when moist; stratified with silt and loamy sand; strongly calcareous; clear, smooth boundary.

IIC3—51 to 60 inches, light reddish-brown (5YR 6/3) clay, reddish brown (5YR 5/3) when moist; weak, fine, angular blocky structure; very hard when dry, extremely firm when moist; abundant salt crystals; strongly calcareous.

The A horizon ranges from 2 to 6 inches in thickness and from sandy clay loam or clay loam to silty clay in texture. The C horizon ranges from heavy clay loam to clay and is interspersed, in places, with thin strata of coarser textured material. The upper part of the C horizon is noncalcareous in some places.

Penistaja Series

The Penistaja series consists of well-drained soils that formed in eolian material weathered from shale and sandstone. These soils are on mesas and plateaus, at an elevation of 6,500 to 7,000 feet. The slope range is mainly 0 to 5 percent. The rainfall totals 12 to 14 inches.

Penistaja soils are finer textured, less deeply leached, and more mature than Berent soils. They are redder than Las Lucas soils.

Typical profile, in native grass meadow located 200 feet south of the NE. corner of sec. 20, T. 20 N., R. 2 W.:

A1—0 to 3 inches, light-brown (7.5YR 6/4) fine sandy loam, dark brown (7.5YR 3/4) when moist; weak, very thick, platy structure; soft when dry, very friable when moist; dispersed surface crust one-eighth inch thick; abrupt, smooth boundary.

B1—3 to 6 inches, light reddish-brown (5YR 6/3) sandy loam, reddish brown (5YR 4/4) when moist; weak to moderate, fine or medium, subangular blocky structure; slightly hard when dry, very friable when moist; abundant roots; clear, smooth boundary.

B2t—6 to 17 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate or strong, medium, subangular and angular blocky structure; very hard when dry, friable when moist; continuous clay films on inner and outer faces of peds; clear, smooth boundary.

B3ca—17 to 21 inches, light reddish-brown (5YR 6/3) sandy clay loam, reddish brown (5YR 4/3) when moist; weak to moderate, medium, subangular and angular blocky structure; very hard when dry, friable when moist; strong, patchy clay films; lime mycelia and a few carbonate concretions; slightly calcareous; clear, smooth boundary.

C1ca—21 to 33 inches, light reddish-brown (5YR 6/4) sandy loam, reddish brown (5YR 4/4) when moist; moderate or strong, coarse, subangular blocky structure; very hard when dry, friable when moist; lime mycelia and a few carbonate concretions; worm casts; slightly calcareous; clear, smooth boundary.

C2—33 to 37 inches, light-brown (7.5YR 6/4) sandy loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; slightly calcareous; clear, smooth boundary.

C3—37 to 45 inches, light yellowish-brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; slightly calcareous; clear, smooth boundary.

R—45 to 60 inches, pale-brown (10YR 6/3) sandy shale, dark brown (10YR 4/3) when moist; massive; slightly calcareous.

The A horizon ranges from 2 to 5 inches in thickness and is fine sandy loam, very fine sandy loam, or loam in texture. The texture of the B horizon is sandy loam to sandy clay loam or light clay loam. The hue ranges from 10YR to 5YR throughout the profile. Leaching extends to a depth of 12 to 24 inches. The depth to sandstone or sandy shale ranges from 36 inches to several feet.

Persayo Series

The Persayo series consists of well-drained, moderately steep and steep soils that formed in material weathered from Cretaceous shale. These soils are on uplands. The slope range is 9 to 25 percent.

Persayo soils are shallower and less mature than Litle soils. They are less well developed and are much shallower than Las Lucas soils.

Typical profile, in native grass meadow located in the SW¼ sec. 32, T. 19 N., R. 3 W.:

A1—0 to 3 inches, light yellowish-brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) when moist; weak, medium, platy structure; slightly hard when dry, very friable when moist; strongly calcareous; many calcium sulfate crystals; abrupt, smooth boundary.

C—3 to 6 inches, light olive-brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) when moist; weak, coarse, subangular blocky structure; hard when dry, very friable when moist; many thin, platy shale particles; many calcium sulfate crystals; abrupt, smooth boundary.

R—6 to 14 inches, gray and olive, calcareous shale.

The A horizon ranges from 2 to 4 inches in thickness and from loam to silty clay loam in texture. The texture of the C horizon ranges from loam to clay loam or silty clay loam. The hue ranges from 10YR to 2.5Y throughout the profile. The depth to shale ranges from 6 to 16 inches.

Prewitt Series

The Prewitt series consists of soils that are deep, well drained, calcareous, and immature. These soils are on flood plains and terraces and along drainageways that originated in sedimentary red beds.

Prewitt soils are coarser textured than Navajo soils and are not so strongly alkali. They are coarser textured and redder than Billings soils. Prewitt soils are less alkali and redder than Christianburg soils.

Typical profile, located in the SE¼ sec. 10, T. 20 N., R. 1 W.:

A1—0 to 8 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) when moist; strong, very fine, granular structure; soft when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

AC—8 to 13 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, very friable when moist; calcareous; pH 8.2; gradual, smooth boundary.

C—13 to 60 inches, reddish-brown (5YR 5/4) loam with thin lenses of sandy loam and loamy sand, reddish brown (5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist; calcareous; pH 8.2.

The texture of the A horizon is sandy loam, loam, or sandy clay loam. The AC and C horizons are highly stratified but are typically medium textured. Small amounts of salts, mainly calcium sulfate, occcur.

Ravola Series

The Ravola series consists of soils that are well drained, slightly calcareous, and immature. These soils formed in material weathered from alkaline shale and sandstone. They are on alluvial fans and flood plains.

Ravola soils are coarser textured than Christianburg soils and Navajo soils. Ravola soils have a surface layer similar to that of Billings soils, but their subsoil is stratified and coarser textured.

Typical profile, in native grass meadow located in the SW¼SE¼ sec. 17, T. 20 N., R. 3 W.:

A1—0 to 10 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure breaking to moderate and strong, fine, granular; hard when dry, very friable when moist; slightly calcareous; abrupt, smooth boundary.

C—10 to 60 inches, light olive-brown (2.5Y 5/3) loam with thin lenses of sandy loam and loamy sand, olive brown (2.5Y 4/3) when moist; massive; hard when dry, very friable when moist; slightly calcareous.

The A horizon ranges from 3 to 12 inches in thickness and from silty clay loam to light clay in texture. The hue ranges from 2.5Y to 10YR.

Shavano Series

The Shavano series consists of well-drained soils that formed partly in eolian material and partly in residual material weathered from sandstone and interbedded shale. These soils are on uplands.

Shavano soils are less leached than Berent soils. They are coarser textured, shallower, and less mature than Penistaja soils. Shavano soils are less mature than Las Lucas soils, which lack a gravelly substratum.

Typical profile, in native grass meadow located in the NE¼ sec. 33, T. 17 N., R. 3 W.:

A1—0 to 4 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) when moist; weak, medium, platy structure; slightly hard when dry, very friable when moist; slightly calcareous; abrupt, smooth boundary.

AC—4 to 16 inches, brown (10YR 5/3) heavy loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure; hard when dry, firm when moist; 15 to 25 percent gravel; few calcium carbonate concretions; very strongly calcareous; clear, smooth boundary.

Cca—16 to 38 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark brown (10YR 4/3) when moist; massive; hard when dry, friable when moist; 40 to 50 percent dark reddish-brown, easily crumbled sandstone fragments; very strongly calcareous; abrupt, smooth boundary.

R—38 inches, sandstone.

The A horizon ranges from 3 to 6 inches in thickness and from loamy sand to fine sandy loam in texture. The depth to sandstone ranges from 20 to 40 inches.

Torreon Series

The Torreon series consists of well-drained soils that formed in material weathered from basalt and volcanic debris. These soils are on the tops of mesas. The slope range is 0 to 3 percent.

Torreon soils formed in the same kind of material as Cabezon soils, but Torreon soils are deeper and more mature.

Typical profile, in native grass meadow located in the center of sec. 3, T. 15 N., R. 4 W.:

A11—0 to 5 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; strong, very fine, granular structure; noncalcareous; clear, smooth boundary.

A12—5 to 9 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) when moist; weak to moderate, fine, subangular blocky structure breaking to strong, very fine, granular; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—9 to 13 inches, brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/2) when moist; strong, fine, subangular blocky structure; very hard when dry, very friable when moist; thin, continuous clay films on most soil aggregates; a few partly weathered basalt fragments; noncalcareous; clear, smooth boundary.

B21t—13 to 30 inches, brown (7.5YR 5/3) clay, dark brown (7.5YR 4/3) when moist; strong, medium, prismatic structure breaking to strong, medium, angular blocky; extremely hard when dry, firm when moist; moderate, continuous clay films on surfaces of soil aggregates; common, well-weathered basalt fragments and grains of dark sand; noncalcareous; clear, smooth boundary.

B22tca—30 to 38 inches, brown (7.5YR 5/3) clay, dark brown (7.5YR 4/3) when moist; moderate and strong, medium, prismatic structure breaking to moderate and strong, medium, angular blocky; thin, nearly continuous clay films on surfaces of soil aggregates; extremely hard when dry, firm when moist; visible calcium carbonate occurring as large, soft concretions; common sand and gravel and basalt fragments, but not so strongly weathered as those in the B21t horizon; weakly calcareous to noncalcareous; gradual, smooth boundary.

B3ca—38 to 60 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, prismatic structure breaking to weak to moderate, medium, angular blocky; very hard when dry, firm when moist; thin, patchy clay films on both horizontal and vertical faces of soil aggregates; moderate amount of basalt fragments, sand, and gravel; calcareous; moderate to strong accumulation of carbonates with visible calcium carbonate occurring as large concretions, thin seams, streaks, and finely divided flourlike forms.

The A horizon ranges from 4 to 12 inches in thickness and from loam to light clay loam in texture. In slight depressions, the A horizon is thicker, darker colored, and higher in organic-matter content. The B horizon ranges from 3 to 4 feet in thickness and from clay loam to silty clay or clay in texture.

Travessilla Series

The Travessilla series consists of well-drained, calcareous soils that formed in coarse-textured residual material weathered from sandstone. These soils are on uplands.

Travessilla soils are coarser textured than Persayo soils, which formed in material weathered from shale. They are shallower than Berent soils.

Typical profile, in native grass meadow located in the NE¼ sec. 4, T. 19 N., R. 1 W.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

C—3 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; soft when dry, very friable when moist; calcareous; pH 8.0; abrupt, smooth boundary.

R—8 inches, sandstone.

The A horizon ranges from 2 to 6 inches in thickness and from fine sandy loam to loamy sand in texture. The depth to bedrock ranges from 6 to 16 inches.

General Nature of the Area

The Cabezon Area is part of the Colorado Plateau, which at one time was covered by a shallow sea. Periodically, the land rose above this sea and then fell. As a result, more than 4,000 feet of sandstone and shale interbedded with thin coal seams was formed. Sandstone is resistant to erosion; shale erodes readily. Where sandstone is predominant, steep cliffs have formed. Where shale is predominant, Badland has formed.

This Area consists mostly of a series of mesas that have nearly flat tops and almost vertical escarpments. From north to south, each succeeding mesa is 200 to 500 feet lower in elevation.

The Rio Puerco, a tributary of the Rio Grande, is the principal drainageway and the only perennial stream in the Area. Draining into the river are many arroyos in which water flows intermittently. The upper courses of these arroyos are very narrow, typically have vertical walls, and are actively eroding. The lower courses are nearly level and fairly wide and are partly filled with sand. As a result of severe erosion of the soils in the watershed, the Rio Puerco carries an unusually heavy load of sediment. Although this river drains only about 20 percent of the Upper Rio Grande Basin and collects less than 8 percent of the water from this drainage area, it carries almost half of the sediment (*3*, *5*).

Pinyon and juniper grow throughout the Area, except on the finer textured soils underlain by shale. Ponderosa pine is scattered at the higher elevations in the northeastern and southwestern parts. Blue grama, galleta, and alkali sacaton, in that order, are the principal grasses. Big sagebrush covers large areas of the uplands, and chamiza, shadscale, and greasewood grow along drainageways where the soils are saline and alkali.

A more detailed description of the vegetation is given in the section "Range Management."

Water Supply

Earthen dams constructed in drainageways supply most of the water for livestock. Three or four springs have been developed to supply water for domestic use and for livestock. The Navajo Indians haul water from these springs and from two or three shallow wells dug along the larger drainageways. The geological formations must be studied carefully before drilled wells are planned.

The lack of adequate watering facilities is a serious limitation in distributing livestock over the range.

Climate [6]

The Cabezon Area has a semiarid climate with pleasant summers and fairly long, cold winters. In winter, moisture comes from the Pacific Ocean, about 600 miles west of the Area, and in summer, from the Gulf of Mexico, about 800 miles southeast. Generally, the moisture from the Pacific Ocean is precipitated before it reaches the Area, and consequently winters are dry. The moisture from the Gulf moves northward with the general wind currents and accounts for most of the annual rainfall.

[6] This section was prepared by Frank E. Houghton, State climatologist, United States Weather Bureau.

Table 7.—*Temperature and precipitation data*

[Temperature data from Cuba for 1938–61. Precipitation data from Johnson Ranch (Johnson Trading Post) for 1944–62]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—		Average number of days with precipitation of—	
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—	0.10 inch or more	0.25 inch or more
	°F.	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*		
January	42	10	56	−11	0. 69	0. 3	1. 2	2	1
February	44	14	59	5	. 46	. 1	. 9	2	1
March	51	20	68	7	. 79	[1]. 005	1. 7	2	1
April	62	27	75	15	. 74	. 1	1. 7	2	1
May	72	35	84	24	. 67	. 1	1. 6	2	1
June	84	42	94	33	. 42	[1]. 005	1. 0	1	(2)
July	87	50	96	43	1. 37	. 4	2. 6	4	3
August	84	49	92	40	3. 62	. 8	5. 0	5	3
September	79	41	90	30	. 78	[1]. 005	2. 3	2	1
October	68	29	80	18	1. 17	[1]. 005	2. 6	2	2
November	53	17	66	2	. 47	. 1	1. 2	2	(2)
December	45	10	60	−6	. 65	. 1	1. 6	2	1
Year	64	29	[3] 95	[4] −17	11. 83	7. 4	13. 0	28	15

[1] The smallest measurable amount.
[2] Less than 0.5 day.
[3] Average highest maximum.
[4] Average lowest minimum.

Table 7 shows temperature data recorded at the U.S. Weather Bureau Station at Cuba, which is just outside the eastern edge of the survey Area, and precipitation data recorded at the station at Johnson Ranch (Johnson Trading Post) within the Area. These data are fairly representative of the Cabezon Area.

The highest temperature that has been recorded at Cuba is 102 degrees. Readings as high as 100 degrees are rare. The lowest temperature recorded is −40 degrees. A temperature higher than 90 degrees occurs on an average of 22 days a year, mostly during June and July. The temperature reaches a high of 32 degrees or less on an average of 10 days a year, between the first of December and the end of March. It drops to 32 degrees or less on an average of 211 days and to zero or less on an average of 16 days. Freezing temperatures have been recorded in every month except July.

The average rainfall ranges from about 14 inches in the northern and eastern parts of the Area to about 10 inches in the southern part. Summer thunderstorms bring about 40 percent of the annual rainfall during July and August. The amount and distribution of rainfall are extremely variable. For example, rainfall totaled 16.74 inches in 1957 and 4.50 inches in 1956. A total of 5.05 inches fell in August in 1947, whereas none falls in some months. On one day in August 1947 there was a rainfall of 1.64 inches.

A measurable amount of snow can be expected in the Area at any time between October 1 and April 30. The average annual snowfall at Johnson Ranch amounts to nearly 40 inches. The greatest amount in one season was 62 inches in the winter of 1961–62, and the greatest amount in one month was 23 inches in March 1946.

The relative humidity is about 57 percent. It ranges from nearly 75 percent in winter to 45 percent late in spring and early in summer. A cloud cover can be expected about half the time. The sun shines on an average of about 70 percent of the days throughout the year.

Westerly winds prevail in winter, but locally, wind direction is affected by topography. The average wind velocity is 10 miles an hour; it increases to 13 miles in spring. Tornadoes occur only about once in 20 years.

Table 8 shows the probabilities of freezing temperatures after specified dates in spring and before specified dates in fall. The probabilities are based on data recorded at Cuba. These data are considered fairly representative of the Cabezon Area, though the temperatures at Cuba are affected by cold air drainage from higher areas nearby and are likely to be a few degrees lower than those in the Cabezon Area.

TABLE 8.—*Probabilities of freezing temperatures in spring and fall*

[Data obtained from records at Cuba for 1948–60]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	April 28	May 5	May 20	June 13	June 21
2 years in 10 later than	April 21	May 2	May 16	June 7	June 16
5 years in 10 later than	April 6	April 24	May 6	May 26	June 6
Fall:					
1 year in 10 earlier than	October 21	October 5	September 30	September 19	September 8
2 years in 10 earlier than	October 26	October 11	October 6	September 24	September 12
5 years in 10 earlier than	November 3	October 22	October 16	October 5	September 23

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Glossary

Acidity. (See Reaction, soil.)

Aggregate, soil. Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crops is impaired.

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where its gradient decreases abruptly.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, mineral particles less than 0.002 millimeter in diameter. As a textural class, soil that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Genesis, soil. The manner in which a soil originated, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

Horizon, soil. A layer of soil, approximately paralled to the soil surface, that has distinct characteristics produced by soil-forming processes.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the surface soil and subsoil and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Loam. Soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Mature soil. A soil that has well-developed soil horizons produced by the natural processes of soil formation and is essentially in equilibrium with its present environment.

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, mineralogical, and biological properties of the various horizons of the soil profile.

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system, made because of differences that affect the management of soils but not their classification. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Piping. The formation of underground channels that result in gullies and sinkholes.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff (hydrology). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz, but sand may be of any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil.

Texture, soil. The relative proportion of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Type, soil. A subdivision of a soil series, made on the basis of differences in the texture of the surface layer.

GUIDE TO MAPPING UNITS

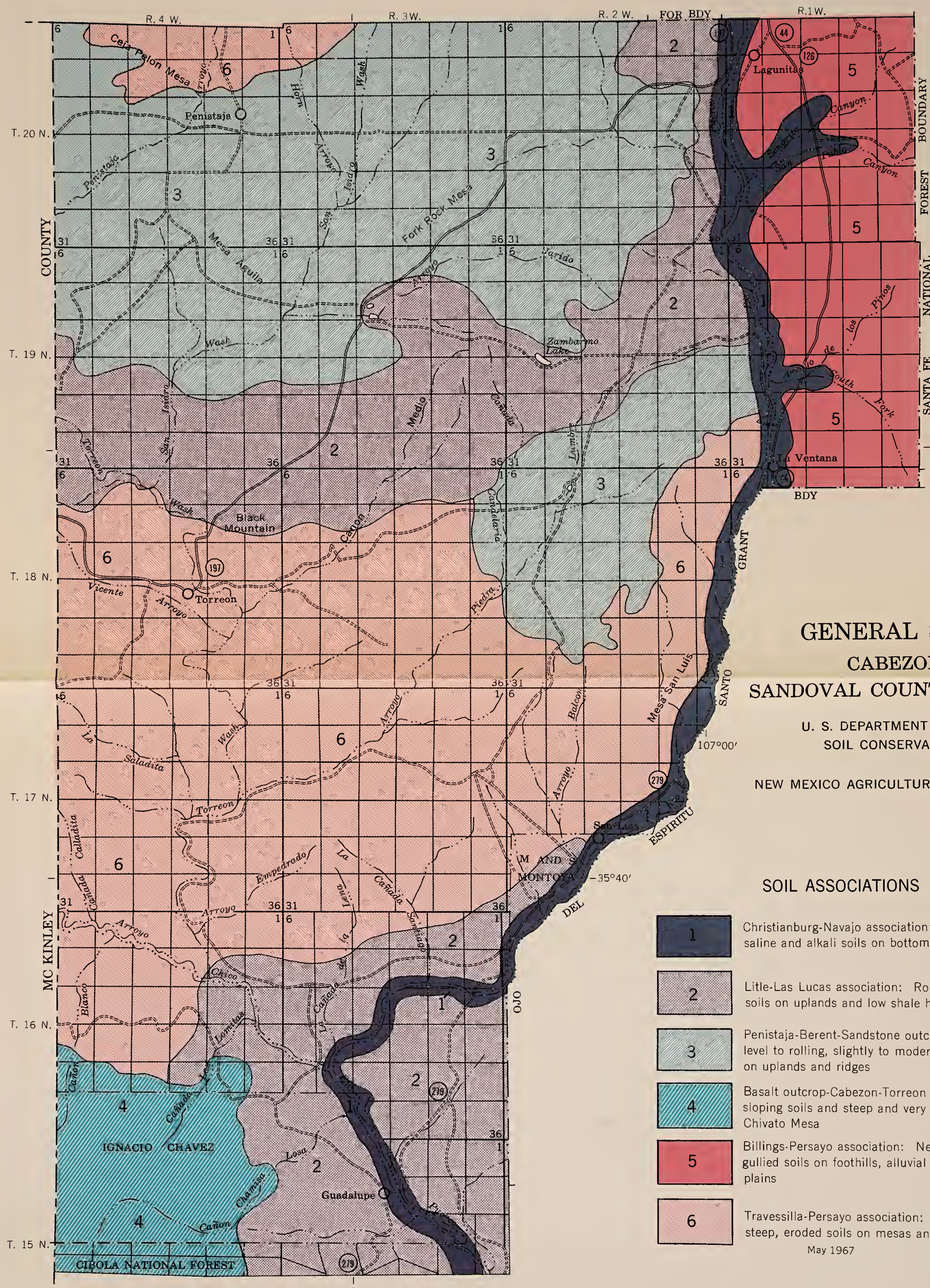
[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

[See table 1, page 5 for approximate acreage and proportionate extent of the soils. See table 2, page 15, for capability classification of the soils, by climatic zones. For facts about the engineering properties of the soils, turn to the section beginning on page 23, and for facts about woodland and wildlife, see page 23]

Map symbol	Mapping unit	Described on page	Range site 1/ Name	Page
Ak	Alkali alluvial land	5	Salt Flats, zones 5 and 6	21
Au	Alluvial land	5	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
Ba	Badland	6	None	
Bc	Basalt outcrop-Cabezon association	6		
	Basalt outcrop	--	Malpais Breaks, zone 6	22
	Cabezon soil	--	Pine Grassland, zone 4	22
Bd	Berent loamy fine sand, 0 to 5 percent slopes	6	Deep Sand, zones 5 and 6	19
Be	Berent loamy fine sand, 5 to 9 percent slopes	6	Deep Sand, zones 5 and 6	19
Bf	Berent-Sandstone outcrop association	6		
	Berent soil	--	Deep Sand, zones 5 and 6	19
	Sandstone outcrop	--	Sandstone Breaks, zones 5 and 6	21
Bg	Billings silty clay loam and Gullied land	6	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20
Bk	Billings silty clay loam, alkali, and Gullied land	7	Salt Flats, zones 5 and 6	21
Bp	Billings and Persayo silty clay loams	7		
	Billings soil	--	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20
	Persayo soil	--	Shale Hills, zones 5 and 6	20
Cb	Cabezon-Basalt outcrop association	7		
	Cabezon soil	--	Pine Grassland, zone 4	22
	Basalt outcrop	--	Malpais Breaks, zone 4	22
Cg	Christianburg clay and Gullied land	8	Salt Flats, zones 5 and 6	21
Fp	Fronton-Travessilla-Persayo association	8		
	Fronton soil	--	Gravelly Upland, zones 5 and 6	20
	Travessilla soil	--	Shallow Upland, zones 5 and 6	20
	Persayo soil	--	Shale Hills, zones 5 and 6	20
Fr	Fruitland sandy loam	8	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
Fs	Fruitland-Slickspot association	8		
	Fruitland soil	--	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
	Slickspots	--	Salt Flats, zones 5 and 6	21
Lc	Las Lucas loam, 0 to 5 percent slopes	9	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
Ld	Las Lucas loam, 5 to 9 percent slopes	9	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
Le	Las Lucas soils, 5 to 9 percent slopes	9	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20
Lp	Las Lucas-Persayo association	9		
	Las Lucas soil	--	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
	Persayo soil	--	Shale Hills, zones 5 and 6	20
Lr	Litle silty clay, 1 to 5 percent slopes	9	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20
Ls	Litle silty clay, 5 to 9 percent slopes	10	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20
Lt	Litle-Las Lucas-Persayo association	10		
	Litle soil	--	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20
	Las Lucas soil	--	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
	Persayo soil	--	Shale Hills, zones 5 and 6	20
Lu	Litle-Persayo association	10		
	Litle soil	--	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20
	Persayo soil	--	Shale Hills, zones 5 and 6	20
Ng	Navajo clay and Gullied land	10	Salt Flats, zones 5 and 6	21
Pf	Penistaja fine sandy loam, 0 to 5 percent slopes	11	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
Pg	Penistaja fine sandy loam, 5 to 9 percent slopes	11	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
Pn	Penistaja-Berent association	11		
	Penistaja soil	--	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
	Berent soil	--	Deep Sand, zones 5 and 6	19
Po	Penistaja-Sandstone outcrop association	11		
	Penistaja soil	--	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
	Sandstone outcrop	--	Sandstone Breaks, zones 5 and 6	21
Pr	Persayo gravelly soils-Shale outcrop association	11		
	Persayo soil	--	Gravelly Upland, zones 5 and 6	20
	Shale outcrop	--	Shale Breaks, zones 5 and 6	21
Ps	Persayo-Shale outcrop association	11		
	Persayo soil	--	Shale Hills, zones 5 and 6	20
	Shale outcrop	--	Shale Breaks, zones 5 and 6	21
Pw	Prewitt loam and Gullied land	12	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
Rg	Ravola silty clay loam and Gullied land	12	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20
Rk	Ravola silty clay loam, alkali, and Gullied land	12	Salt Flats, zones 5 and 6	21
Rt	Rock outcrop-Travessilla-Persayo association	12		
	Rock outcrop	--	Shale Breaks, zones 5 and 6	21
	Travessilla soil	--	Shallow Upland, zones 5 and 6	20
	Persayo soil	--	Shale Hills, zones 5 and 6	20
St	Sandstone outcrop-Travessilla association	13		
	Sandstone outcrop	--	Sandstone Breaks, zones 5 and 6	21
	Travessilla soil	--	Shallow Upland, zones 5 and 6	20
Sv	Shavano-Berent association	13		
	Shavano soil	--	Loamy Upland, zone 5	17
			Loamy Upland, zone 6	19
	Berent soil	--	Deep Sand, zones 5 and 6	19
To	Torreon loam	13	Mountain Grassland, zone 4	22
Tp	Travessilla-Persayo-Billings association	14		
	Travessilla soil	--	Shallow Upland, zones 5 and 6	20
	Persayo soil	--	Shale Hills, zones 5 and 6	20
	Billings soil	--	Clayey Upland, zone 5	19
			Clayey Upland, zone 6	20

1/ The vegetation on Loamy Upland site, zone 5, and Clayey Upland site, zone 5, is sufficiently different from that on Loamy Upland site, zone 6, and Clayey Upland site, zone 6, that two different descriptions are needed for each of these two sites.

260-195 O - 67 (Face p. 44)



GENERAL SOIL MAP

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

NEW MEXICO AGRICULTURAL EXPERIMENT STATION

SOIL ASSOCIATIONS

1 Christianburg-Navajo association: Nearly level, gullied, saline and alkali soils on bottom lands

2 Litle-Las Lucas association: Rolling or hilly, eroded soils on uplands and low shale hills

3 Penistaja-Berent-Sandstone outcrop association: Nearly level to rolling, slightly to moderately eroded soils on uplands and ridges

4 Basalt outcrop-Cabezon-Torreon association: Gently sloping soils and steep and very steep, stony soils on Chivato Mesa

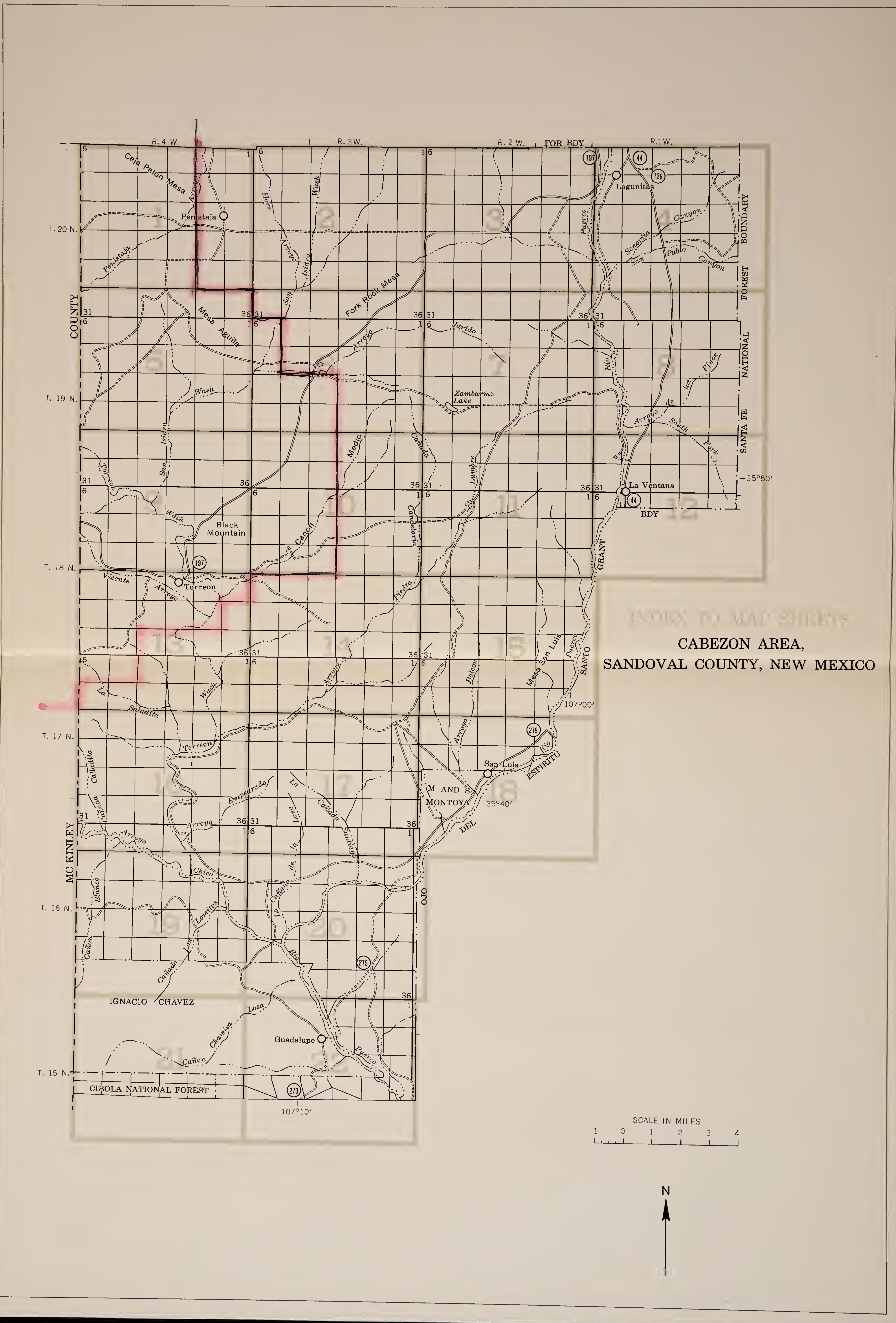
5 Billings-Persayo association: Nearly level to steep, gullied soils on foothills, alluvial fans, and flood plains

6 Travessilla-Persayo association: Strongly sloping to steep, eroded soils on mesas and breaks

May 1967

SCALE IN MILES
1 0 1 2 3 4

N


CABEZON AREA,
SANDOVAL COUNTY, NEW MEXICO
R. 4 W.
R. 3 W.
R. 2 W.
R. 1 W.
FOR BDY
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
T. 16 N.
T. 15 N.
Ceja Pelon Mesa
Penistaja
Fork Rock Mesa
Mesa Aguila
Lagunitas
Señorita
San Pablo
Canyon
Zambarmo Lake
Jarido
Arroyo de los Pinos
South Fork
La Ventana
Black Mountain
Torreon
Vicente
San Isidro
Wash
Medio
Cañada
Candelaria
Lumbre
Piedra
Mesa San Luis
Baloon
La Saladita
Torreon
Calladita
San Luis
M AND S
MONTOYA
Empedrado
Arroyo Chico
Blanco
Lomitas
Cañada de la Leña
Santiago
IGNACIO CHAVEZ
Chamisa
Losa
Guadalupe
Puerco
Cañon
CIBOLA NATIONAL FOREST
COUNTY
MC KINLEY
SANTA FE NATIONAL FOREST BOUNDARY
BDY
GRANT
SANTO
ESPIRITU
DEL
OJO
Rio Puerco
35°50′
35°40′
107°00′
107°10′
SCALE IN MILES
1 0 1 2 3 4
N

SOIL LEGEND

SYMBOL	NAME
Ak	Alkali olluviol lond
Au	Alluvial land
Bo	Bodland
Bc	Bosolt outcrop—Cobezon ossociotion
Bd	Berent loomy fine sond, 0 to 5 percent slopes
Be	Berent loamy fine sand, 5 to 9 percent slopes
Bf	Berent—Sondstone outcrop ossociotion
Bg	Billings silty cloy loom ond Gullied lond
Bk	Billings silty cloy loam, olkali, ond Gullied lond
Bp	Billings ond Persoyo silty cloy looms
Cb	Cobezon—Basolt outcrop ossociotion
Cg	Christionburg clay and Gullied land
Fp	Fronton—Trovessillo—Persayo ossaciation
Fr	Fruitlond sondy loam
Fs	Fruitlond—Slickspot assaciation
Lc	Las Lucas loom, 0 to 5 percent slapes
Ld	Las Lucos loam, 5 to 9 percent slopes
Le	Los Lucas sails, 5 to 9 percent slopes
Lp	Los Lucas—Persayo associotion
Lr	Litle silty cloy, 1 to 5 percent slapes
Ls	Litle silty clay, 5 ta 9 percent slopes
Lt	Litle—Los Lucos—Persoya ossociotion
Lu	Litle—Persoyo ossociotion
Ng	Novojo cloy ond Gullied lond
Pf	Penistojo fine sandy loam, 0 ta 5 percent slopes
Pg	Penistojo fine sondy laom, 5 to 9 percent slopes
Pn	Penistoja—Berent ossociotion
Po	Penistoja—Sondstone autcrop ossaciotion
Pr	Persoyo grovelly soils—Shale autcrop ossaciotion
Ps	Persoyo—Shale outcrop ossociotion
Pw	Prewitt loam and Gullied land
Rg	Rovola silty cloy loom ond Gullied lond
Rk	Rovola silty cloy loom, alkoli, ond Gullied lond
Rt	Rock autcrop—Trovessilla—Persaya association
St	Sondstone outcrop—Travessilla associatian
Sv	Shovano—Berent associotion
To	Torreon loam
Tp	Travessillo—Persoya—Billings ossaciotion

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Good motor
- Poor motor

Highway markers
- U. S.
- State or County

Buildings
- School
- Church

Mine and Quarry

Sawmill

Pits, gravel or other

Power line

Pipeline

Cemetery

Dams

Levee

Retards

Well, oil or gas

Windmill

BOUNDARIES

National or state

County

Township, range, or section line

Land division corners

Land grant, reservation, or area boundary

Small park, cemetery, airport

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent

Lakes and ponds
- Perennial
- Intermittent

Wells, water — flowing

Spring

Marsh

Wet spot

SOIL SURVEY DATA

Soil boundary and symbol — Bd

Rock outcrops

Soil mop constructed 1966 by Cortogrophic Division, Soil Conservotion Service, USDA, from 1954 ond 1958 oeriol photogrophs. Controlled mosoic based on New Mexico plone coordinote system, centrol zone, tronsverse Mercotor projection, 1927 North Americon dotum.

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture,

Ojo Encino Mesa Quad

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 1

R. 4 W.

1

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

This map is one of a se as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 1

2

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 3

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 4

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 4

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 5

(5)

(Joins sheet 1)

(Joins sheet 6)

Old Encino Mesa

channel shifted

Indian

(Joins sheet 9)

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the [illegible]ation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 5

⑥

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 6

(Joins sheet 2)

R. 3 W.

(Joins sheet 10)

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 7

(7)

This map is one of a set compiled in [illegible] as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 7

8

(Joins sheet 4)

N

(Joins sheet 7)

(Joins sheet 12)

0 ½ 1 Mile Scale 1:31 680 0 5 000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 9

(Joins sheet 5)

9

(Joins sheet 10)

(Joins sheet 13)

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

End of walls transfer

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 9

Range, township, and section corners shown on this map are indefinite.

and the New Mexico Agricultural Experiment Station.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 10

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 10

11

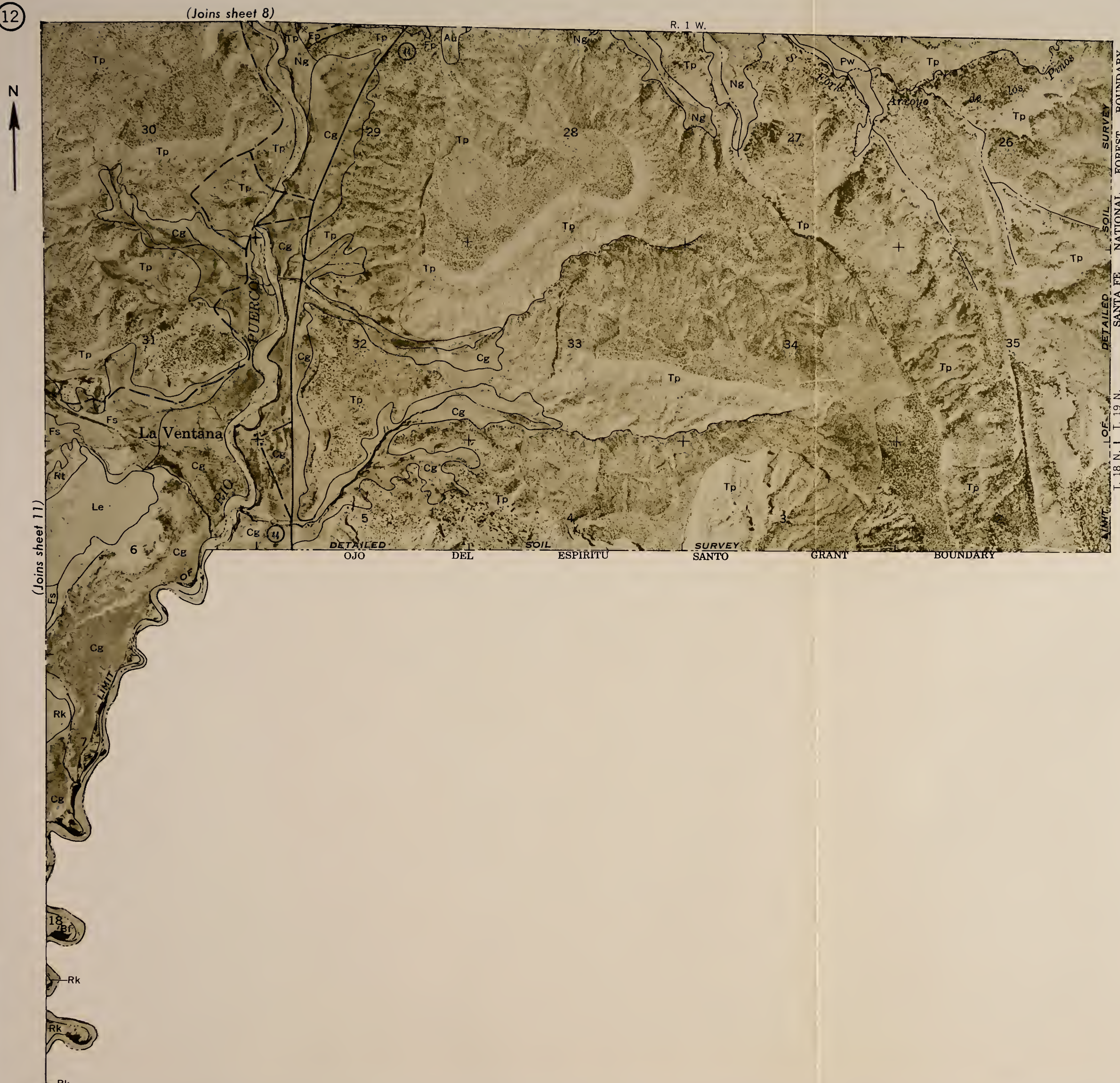
and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 11

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 12

12



0 ½ 1 Mile Scale 1:31680 0 5000 Feet

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 12

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 13

13

and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO.13

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 14

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 15

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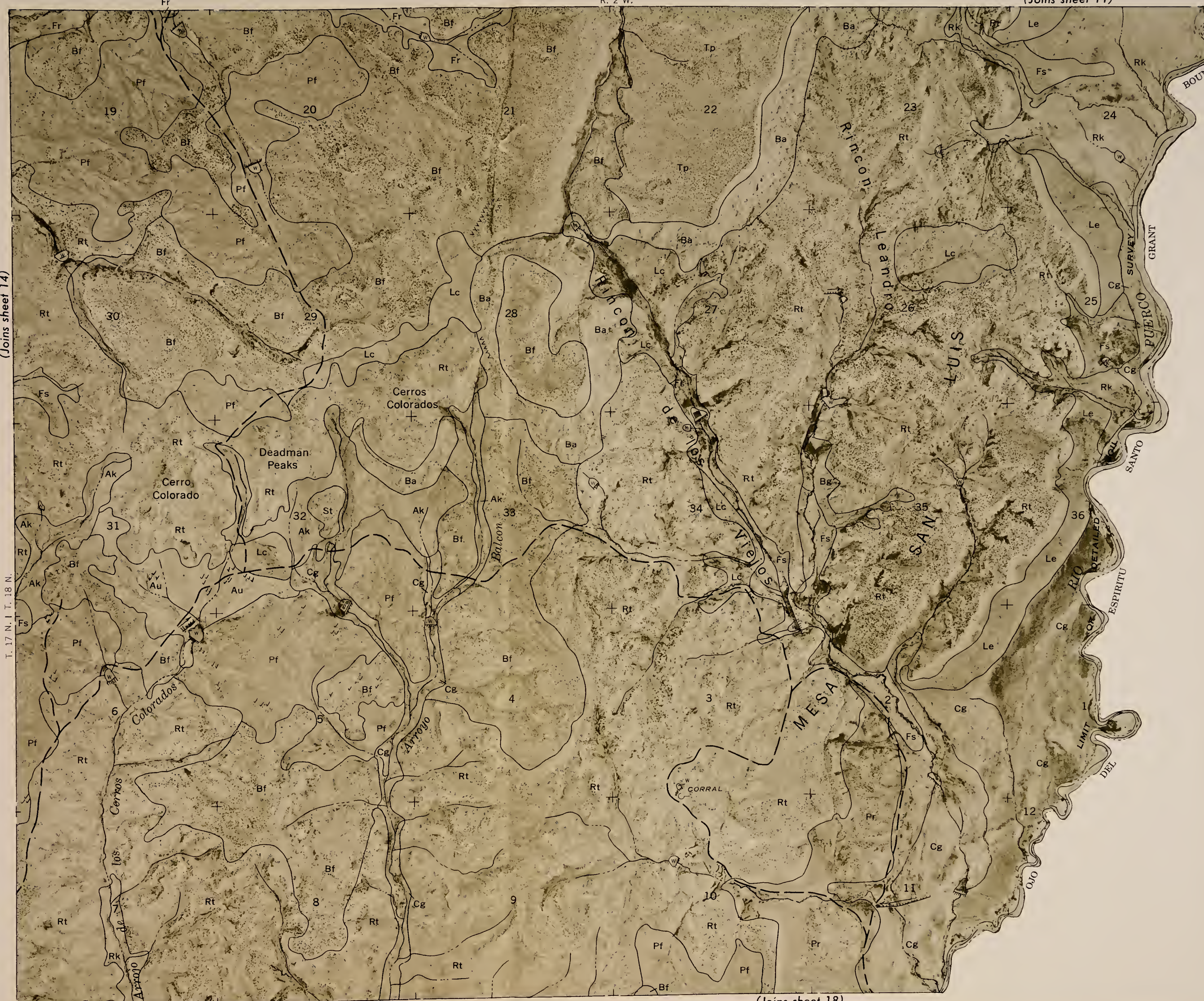
(Joins sheet 14)

T. 17 N. | T. 18 N.



(Joins sheet 18)

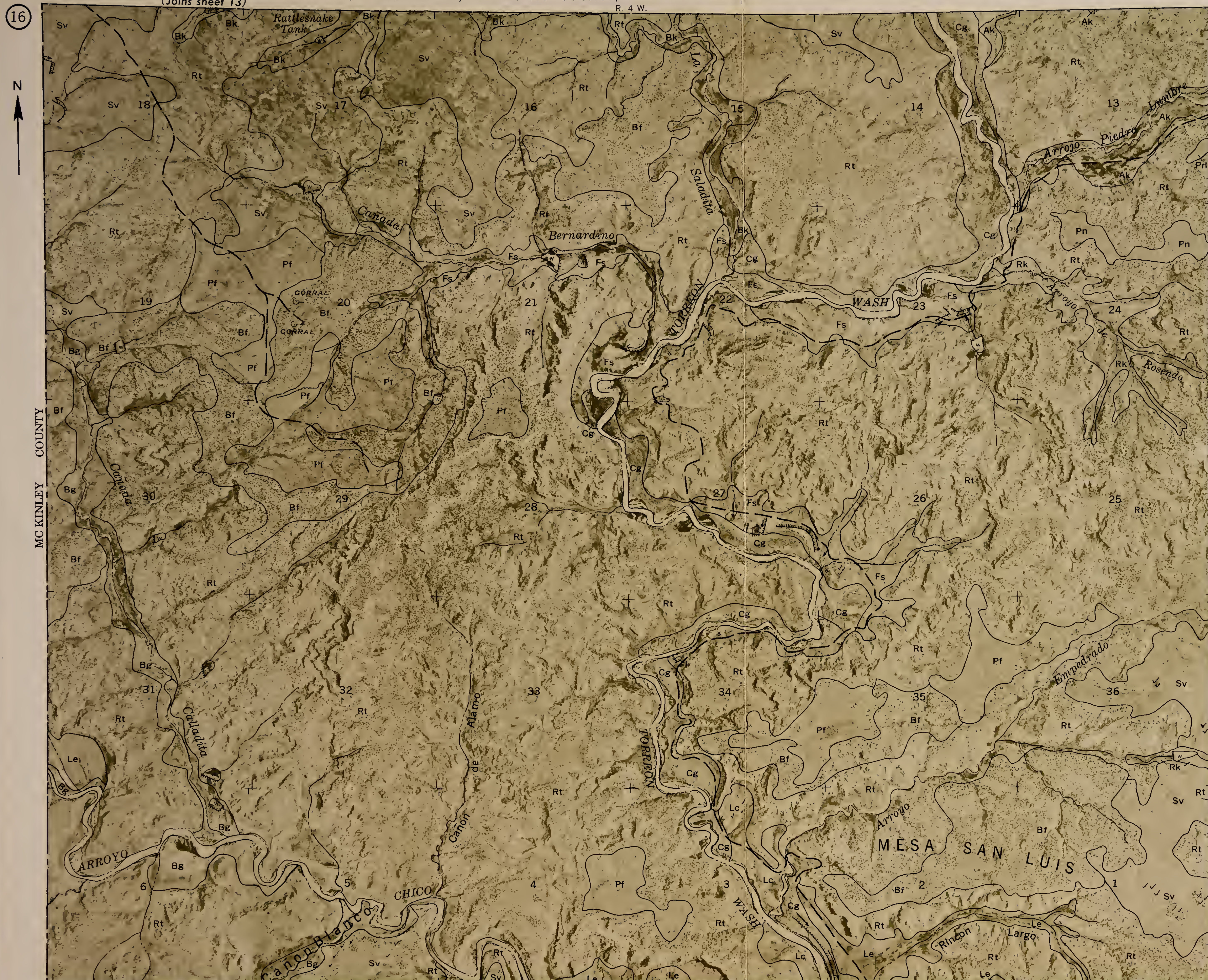
0 1/2 1 Mile Scale 1:31680 0 5000 Feet

N

16

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 16

(Joins sheet 13)



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0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 17

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(Joins sheet 16)

(Joins sheet 18)

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

(Joins sheet 20)

18

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 18

0 ½ 1 Mile Scale 1:31680 0 5000 Feet

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 19

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO — SHEET NUMBER 20

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(Joins sheet 19)

(Joins sheet 22)

Scale 1:31 680

0 — 1/2 — 1 Mile

0 — 5000 Feet

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 20

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the New Mexico Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

CABEZON AREA, SANDOVAL COUNTY, NEW MEXICO NO. 21

0 ½ 1 Mile Scale 1:31 680 0 5000 Feet

Scale 1:31680

0 ½ 1 Mile

0 5000 Feet

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Good motor
- Poor motor

Highway markers
- U. S.
- State or County

Buildings
- School
- Church

Mine and Quarry

Sawmill

Pits, gravel or other

Power line

Pipeline

Cemetery

Dams

Levee

Retards

Well, oil or gas

Windmill

BOUNDARIES

National or state

County

Township, range, or section line

Land division corners

Land grant, reservation, or area boundary

Small park, cemetery, airport

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent

Lakes and ponds
- Perennial
- Intermittent

Wells, water — flowing

Spring

Marsh

Wet spot

SOIL SURVEY DATA

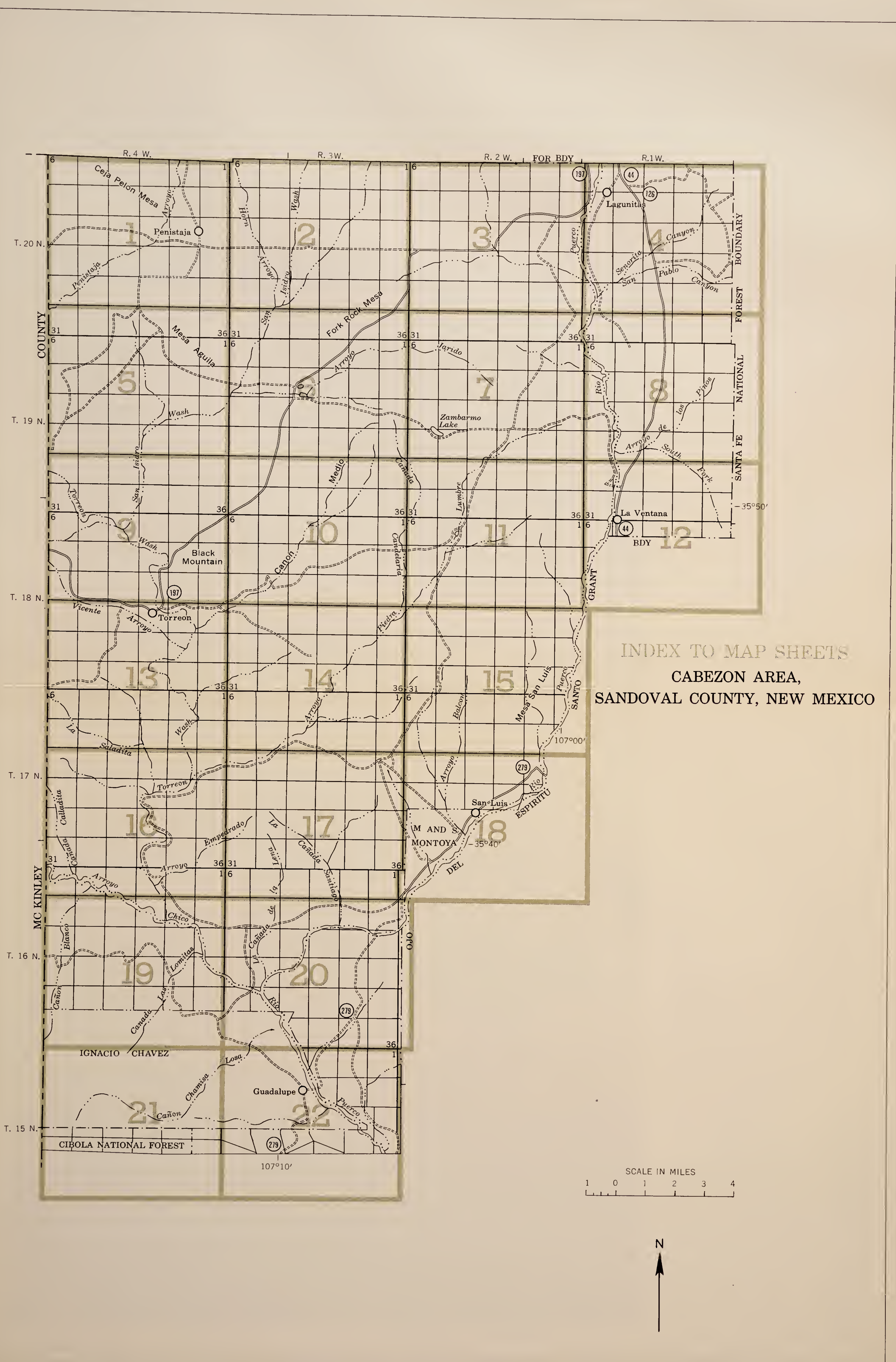
Soil boundary and symbol — Bd

Rock outcrops

SOIL LEGEND

SYMBOL	NAME
Ak	Alkali alluvial land
Au	Alluvial land
Ba	Badland
Bc	Basalt outcrop–Cabezon association
Bd	Berent loamy fine sand, 0 to 5 percent slopes
Be	Berent loamy fine sand, 5 to 9 percent slopes
Bf	Berent–Sandstone outcrop association
Bg	Billings silty clay loam and Gullied land
Bk	Billings silty clay loam, alkali, and Gullied land
Bp	Billings and Persayo silty clay loams
Cb	Cabezon–Basalt outcrop association
Cg	Christianburg clay and Gullied land
Fp	Fronton–Travessilla–Persayo association
Fr	Fruitland sandy loam
Fs	Fruitland–Slickspot association
Lc	Las Lucas loam, 0 to 5 percent slopes
Ld	Las Lucas loam, 5 to 9 percent slopes
Le	Las Lucas soils, 5 to 9 percent slopes
Lp	Las Lucas–Persayo association
Lr	Litle silty clay, 1 to 5 percent slopes
Ls	Litle silty clay, 5 to 9 percent slopes
Lt	Litle–Las Lucas–Persayo association
Lu	Litle–Persayo association
Ng	Navajo clay and Gullied land
Pf	Penistaja fine sandy loam, 0 to 5 percent slopes
Pg	Penistaja fine sandy loam, 5 to 9 percent slopes
Pn	Penistaja–Berent association
Po	Penistaja–Sandstone outcrop association
Pr	Persayo gravelly soils–Shale outcrop association
Ps	Persayo–Shale outcrop association
Pw	Prewitt loam and Gullied land
Rg	Ravola silty clay loam and Gullied land
Rk	Ravola silty clay loam, alkali, and Gullied land
Rt	Rock outcrop–Travessilla–Persayo association
St	Sandstone outcrop–Travessilla association
Sv	Shavano–Berent association
To	Torrean loam
Tp	Travessilla–Persayo–Billings association

Soil map constructed 1966 by Cartographic Division, Soil Conservation Service, USDA, from 1954 and 1958 aerial photographs. Controlled mosaic based on New Mexico plane coordinate system, central zone, transverse Mercator projection, 1927 North American datum.



INDEX TO MAP SHEETS
CABEZON AREA,
SANDOVAL COUNTY, NEW MEXICO
R. 4 W.
R. 3W.
R. 2 W.
FOR BDY
R.1W.
T. 20 N.
T. 19 N.
T. 18 N.
T. 17 N.
T. 16 N.
T. 15 N.
MC KINLEY
COUNTY
SANTA FE
NATIONAL
FOREST
BOUNDARY
GRANT
BDY
SANTO
ESPIRITU
OJO
DEL
M AND S
MONTOYA
IGNACIO CHAVEZ
CIBOLA NATIONAL FOREST
Penistaja
Lagunitas
La Ventana
Black Mountain
Torreon
San Luis
Guadalupe
Zambarmo Lake
Ceja Pelon Mesa
Fork Rock Mesa
Mesa Aguila
Mesa San Luis
−35°50′
−35°40′
107°00′
107°10′
SCALE IN MILES
N